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THE AGARICACEAE OF MICHIGAN

BY

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MUSHROOM POISONING
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No one who has not followed the development of the study of mycology in its scientific or popular fields during the last twenty years can realize its development and the changes in our views that have taken place. Within this time a number of popular works have appeared, keeping pace with the great volume of general nature literature. Mycological and toadstool clubs have been organized in many cities in order to interest people in this fascinating branch of botany. Such clubs have easily won the Interest of people at large because of their appeal on the score of mycophagy, the eating of fungi. In the purely botanical and technical field, colleges, universities and state herbaria have given more and more attention to the scientific and economic aspects of mycological study and have brought about the publication of journals devoted exclusively to studies made in these specialties. For centuries almost every community has had its enthusiastic amateur botanist who has collected and sought to name—to classify—the higher plants of his hunting ground. Now cometh also the humble collector of toadstools and mushrooms who finds that his hobby meets with sympathy and interest. Thus "The Spectator" in Outlook (January 13, 1915) gives a charming account of his initiation into the accuracies and delights of mycology.

*The author would acknowledge his thanks to the libraries of Parke, Davis & Co., to the University of Michigan and to the Wayne County Medical Society, as well as to Professor Kauffman and to numerous private correspondents and co-workers whose services have aided in the preparation of this paper. Our knowledge of mushroom poisoning is still far from complete and further aid from any source will be welcomed.

Detroit, Michigan, 507 Field Ave., March, 1915.

It has been the purpose of Dr. Kauffman to supply in these volumes a manual for the use of both the amateur and advanced student of the Agaricaceae or gilled fungi of Michigan. It is similarly the purpose of this chapter on mushroom poisoning to place before layman, mycologist, mycophagist and physician an account of the present state of our knowledge of the subject. Having in mind such a varied class of readers, the author must include matter which will seem hopelessly technical to the one, and matter that may seem superfluously simple to the other. It is not the purpose of the paper to present much that is either new or original but it does seem possible, in the light of recent advances, to record more vital information about deleterious and suspected species than is to be found in similar articles in all the text books combined. The strictly technical literature of the subject is very large. A bibliography might easily include one hundred books and papers in French, German and English. Most of these are quite inaccessible to the average student and an attempt is made herein to present part of the matter they contain. No popular handbook covers a tenth of the field. The earliest views, still popularly held, regarded the Agarics as a large group of poisonous plants. Then, under the influence of teaching-mushroom-clubs and the invaluable published results of Peck and of McIlvaine and Macadam, the impression that there were but few deleterious and hundreds of edible species, has led to a reckless mycophagy which resulted in the discovery of new harmful species. These can no longer "be counted on the fingers" (Plowright), nor will Bagnall's "dozen in over a thousand edible" include all the toxic species. The bibliography, On Mushroom Poisoning, will guide

the reader to the sources found most useful in the preparation of the paper.

A number of factors give my co-toxicology or mushroom intoxication increasing importance. The daily press endeavors to keep alive the fear of "mistaking a toadstool for a mushroom" in its frequent reports of the disastrous consequences of such a blunder if the toadstool is eaten, but the Sunday paper is not so consistent inasmuch as it prints and reprints irresponsible articles or quotes unreliable and dangerous rules and tests to apply, which, if followed, will lead the man of newspaper education into real danger. The enormous influx of foreigners from southern Europe, accustomed to seeing in the markets and gathering and eating certain species of higher fungi at home, gives us individuals who mistake some American deleterious species for an edible European one which resembles it. These people furnish most of the cases of poisoning which occur in the United States. It is affirmed that nearly all of more than thirty deaths from mushroom poisoning in and near New York City in 1911 occurred among them[39].* Through the growth of nature and mycological clubs, the sale and use of the several excellent popular books and bulletins, and the offering of wild species for sale in our markets, the use of fungi for food is rapidly increasing. This necessarily means that a larger number of poisonings of both major and minor importance will come about, since insufficiently trained, self-constituted "experts" may blunder or fall into minor error. Some reasons for even the well trained student going a bit wrong will appear in other paragraphs. If he will but report his error in the manner indicated below much, or even all, may be forgiven or even approved.

*For numerical references see bibliography: On Mushroom Poisoning.

Mushroom poisoning must have been fairly frequent in early times since it is well known that the Romans employed fungi in great quantity both as delicacies and as daily food. Paulet, in 1793, records their collection in Russia, China, Hungary, Italy and especially in Tuscany, and their public sale in Pekin, Petrograd and Florence. Thus they have numbered among their victims the family of the Greek poet Euripedes, a wife, two sons and a daughter, Pope Clement VII, Emperor Jovian, Emperor Claudius, King Charles VI of France, and Czar Alexsis of Russia[1]. The Princess of Conti nearly lost her life through mistaking *Amanita muscaria* for *A. caesarea*. Definite knowledge of the number of fatalities from mushrooms begins with Paulet who states that from the year 1749 to 1788 there were a hundred deaths in the environs of Paris alone. More recently (1883) Bardy reported 60 cases in 6 years in Les Vosges, and Guillard (1885) estimated 100 deaths annually in southwestern France. Falck collected 53 cases in Germany with 40 deaths and Inoko in Japan reports 481 cases of mushroom intoxication in 8 years (1889). In this country Palmer, of Boston, collected 33 cases with 21 deaths and Forster, of Charlestown, 44 cases with 14 deaths[1]. Bagnall[2] quotes Clark and Smith to the effect that in one ten-day period (September, 1911), 22 deaths occurred in New York City and vicinity, 15 in 1906 and 30 cases with 12 deaths in 1905. In 1913 there were 26 cases of poisoning in Hartford in a few weeks. In 1900 Gillot found over 200 authentic cases of mushroom poisoning mostly in France (123 fatal due to *Amanita phalloides*) and Ford[3] added nearly as many more recorded in the German, English and French literature since 1900. Sartory, in France, records for the summer of 1912, 249 cases of fungus poisoning with 153 deaths. Of these 90% occurred in 15 days[1]. Ford is convinced that the majority of cases do not find their way into medical literature. I do not believe that 10% do. Thus in one summer there were unreported 2 cases (not fatal) in Baltimore, 2 deaths in Cleveland, 9 poisoned in Fostoria, Ohio with several deaths, and 10 in Toronto with 2 deaths. Murrill[7] estimates the annual deaths in the United States as probably 50 or more, as many are not reported. My own records, by no means complete, for southeastern Michigan only, for 10 years show 77 cases with 16 deaths. None reported medically. Most cases undoubtedly escape publicity.

POISONING BY WHITE-SPORED AGARICS

AMANITA PHALLOIDES

(See *A. verna*, *virosa* and *bisporiger*.)

Amanita phalloides is by long odds the most important of all poisonous mushrooms. It is widely distributed, common throughout most of the season and often exceedingly abundant. It is innocent in appearance, of delicious taste and of extreme toxicity. In considering it we may regard *A. verna*, *A. virosa* and *A. bisporiger* as included under the term "*A. phalloides*." Bulliard a hundred years ago gave it the common name "Destroying Angel." It is also known as the Death Cup, White or Deadly Amanita. The earlier species, named in Europe, such as *Amanita bulbosa* and its varieties, *alba*, *citrina*, *virescens* and *olivacea*, *Agaricus bulbosus*, *Amanita viridis*, *A. venenosa* and a number of others are without doubt identical. In older French literature it is known as *l'orange cigue*, *l'orange souris*, l'*orange blanche ou citronee*, *l'orange cigue jaunâtre* and *l'argaric bulbeux* and in German as *Giftwulstling* and *Knollenblaetterschwamm*.[1] Its identification is comparatively simple even in its disguises and no one who does not know this fungus well should dare to eat wild mushrooms or to recommend a portion of such to his neighbor. The possibility of its presence in a collection intended for the table should always be rigorously excluded. The 153 deaths of 1912, above mentioned, were due chiefly to *A. phalloides*. Gillot's thesis[4] maintains that all fatal cases are due to this Agaric. This is not strictly true. The statement that nine-tenths of all fatal cases are due to it, seems conservative enough. In 1845 Orfia reported 8 ill and 4 dead from its ingestion; Bock Ziemssen, 11 fatal cases; Mautner (1861), 4 cases with one death; Handford (Lancet, 1886), 2 fatal; Palmer, 16 cases, 7 fatal; Tappeiner, 5 cases, 2 fatal; Pfromm, 4 Italians, all died; Plowright, 6

cases, 4 fatal; Bulletin of French Mycological Society, 18 deaths 1900-07; in October, 1884, eleven children died in an orphanage in 5 days. Incomplete records for southeastern Michigan (10 years) show 16 deaths in 44 due to *phalloides* illnesses. In 22 of this 44 the white the Amanita was surely to blame, in 14 probably, in 5 presumably.

Surprisingly small quantities may bring on fatal consequences and there are numerous deaths on record from eating one or two good-sized specimens.[1] Plowright[5] has reported the death of a child of ten years from one-third of the top of a small plant eaten raw; Pfromm, that of two children after taking a bit of juice soaked into bread.

The mortality from *A. phalloides* intoxication is extremely high, varying from 60 to 100 per cent and is dependent largely upon the amount ingested and probably somewhat upon the treatment.[1] Sixty to one hundred percent seems too high for adults, judging from local cases. One-half this would be more nearly correct, unless much is eaten or several children are included in each group. Recovery may be regarded as rare but not impossible. It may follow eight to twenty-one days of extreme suffering. Practically all deaths from mushrooms are attributed to this one species.

The cruelty of the poison and the horrible suffering it causes its victim may be faintly realized from a perusal of the clinical histories of the more fully reported cases. One gets the impression that scarcely another agent bears equal power to torture. A few typical, though varied, cases may be briefly quoted. Thus an Italian family at 6 p. m. on Sunday ate heartily of a cooking of fungi. By midnight vomiting had begun, attended by violent abdominal pain, headache and extreme thrist. A doctor was summoned the next morning. The father was cyanotic and twitching and delirious. The pupils were contracted. He improved slightly for a few hours. Periodical remissions and exacerbations of symptoms continued for eight days when coma and death supervened. The mother presented similar symptoms, with thirst and vomiting more violent, miscarried at five months and also died on the eighth day. Both children died in 58 hours. (Pfromm.[6])

The Deep Valley, Pennsylvania, cases occurring in August, 1907, are of especial interest.[8] About 7 p. m. on Sunday a physician, three others and the man-of-all-work ate one quart of mixed fungi fried in flour and butter. Before 2 a. m. all began to suffer from excessive vomiting and violent diarrhea which continued all day Monday. Atropine, narcotics and an oil purgative were given. The gastrointestinal symptoms continued three clays accompanied by subnormal temperature, more or less delirium (no salivation or urinary suppression) and in case of Dr. D., severe muscular cramps of limbs and abdominal muscles. His death occurred on Thursday morning. By Saturday the man-of-all-work was up and about, the three others still abed. In these, vomiting and diarrhea had ceased and an enlarged liver, distended gall bladder and jaundice were appearing. The man who had gathered the fungi conducted the investigator to the place and indicated the varieties gathered and what had constituted most of the lot. These were *Amanita phalloides*, with smaller numbers of Cantharellus, *Amanitopsis vaginata* and a very few *Russula emetica*.

The following group of cases is very typical. In September, 1911, six persons were poisoned, two fatally, in Cleveland. The children, aged four and six, had a little gravy and recovered after nausea, vomiting and diarrhea. Mr. C., aged 67, ate some at supper, felt bad during the night but ate more for breakfast! About noon violent illness began with intense pain in the epigastrium, vomiting and diarrhea with loss of control, clonic spasms and great prostration. Urinary suppression was obstinate and lasted till death, three days after the first meal. Mrs. C., aged 65, ate one forkful at the first meal but did not like the taste. Profuse vomiting and diarrhea with great prostration began one hour after Mr. C.'s symptoms. She recovered rapidly after two days. The daughter-in-law, aged 40, ate at the second meal and, though feeling hot and feverish, ate more at noon! Eight hours later she had exactly the same symptoms as Mr. C. The physician arrived early on the next day. He gave oil, began stimulations with strychnia, nitroglycerin, aromatic spirits of ammonia and, after removal to the hospital, saline solution continuously and oxygen. Some improvement was noted except that the heart action was weak and intermittent and the extremities could not be kept warm. Hiccough for two days, great agony and unconsciousness preceded death on the seventh day. A son, aged 19, ate the second meal—breakfast. Though feeling bad, he worked until 4 p. m. By 9:30 he presented the same symptoms as mother and grand-father. After ten days of apparently as grave illness as theirs under "most terrific stimulation" (nitroglycerin, strychnia, oxygen and salines) he was reported out of danger though "looking like a corpse." "The fungi were gathered from a shady hillside. Some were over six inches across and white inside and out; others were yellow as saffron through and through and about four inches across. Others were white outside and brown under; some were small, white on top and pink under."[9] The brief case histories leave no doubt as to *Amanita phalloides* being the offender. The botanical notes admit of considerable speculation. In every respect this report is pregnant with meaning—and full of food for reflection—for the student of toadstool poisoning.

Grouping the clinical histories from numerous sources the symptomatology of *phalloides* intoxication may be described. When due to the deadly Amanita alone the clinical symptoms are practically always the same and are characteristic. Nevertheless IN EVERY CASE OF POISONING the etiology, i. e., WHAT FUNGUS HAS BEEN EATEN should by all means be determined at the earliest possible moment! Why? Not only for its scientific importance to myco-toxicology but more especially for guidance as to what treatment is indicated and required and very especially what the outlook may be for the patient. If *A. phalloides* can be ruled out the

prognosis at once becomes very much better and useless fears may be allayed. The sufferer is entitled to this. Uneaten fungi should be submitted to competent authority, more should be gathered from the sources whence the suspected species were derived, and the opinion of the patient or of some one who gathered them with or for him as to their identity with those eaten, obtained.—Returning to symptomatology: After ingestion there is a prodromal stage of from six to fifteen hours—generally over ten—in which little or no discomfort is felt. Then follows a sudden seizure of extreme abdominal pain, cramp-like in character, accompanied by vomiting and diarrhea of undigested food, with blood and mucus. Discharges soon become cholera-like (serous) or rice-water in character. There is burning, consuming thirst. Anuria is usual; constipation rare. Prostration and sleeplessness, with the great nervous restlessness of weakness and suffering, are conspicuous. Muscular spasms in various groups are frequent, accompanied by cries or screams of pain. Loss of strength is rapid and excessive. Periods of pain and vomiting alternate with remissions and ameliorated symptoms. Haemaglobinuria does not occur. Within a few days jaundice, cyanosis and coldness of the skin and extremities develop followed by profound coma from which the patient does not rally. Ocular symptoms, the pupils varying, and convulsions are rare but may occur. Convulsions are often terminal, and death is due to cardiac failure. The course of the disease requires from four to six days in children and eight to ten in adults but death may occur within 48 hours if large quantities of the fungi have been eaten or they have not been thoroughly cooked. These points should be weighed in considering prognosis. The resemblance of the clinical picture to that of cholera and to acute yellow atrophy of the liver has often been remarked.

Atypical features occur especially in cases where *Amanita phalloides* was not proven to have been the sole etiological factor. Such cases may show dilated pupils, clear cerebration, albuminuria.[2] Schuerer's six cases—most thoroughly studied and reported[10]—showed cramps in calf of leg, arms and other muscles, the left arm escaping in one. Many days of pains in the legs persisted. Recovery was more or less rapid according to age but the youngest (5) died in thirty-five hours after violent convulsions and coma. If recovery takes place the liver and spleen enlarge about the third day, after which day, according to Maass,[12] the prognosis becomes better. "In clear-cut cases the physician can diagnose the variety of toadstool from the typical symptoms."[10]

Reports on the post mortem findings in man in fatalities due to *A. phalloides* are not overly satisfactory. There is little to be found to account for the violent paroxysms of pain, vomiting and diarrhea. Schuerer found, in a child, colitis, pleural haemorrhages and fatty degeneration of liver, heart and kidneys. Microscopically there were "Very wide-spread and obviously severe lesions of the cell elements of the central nervous system, as heretofore hardly known in this form and to this extent"—regressive changes like those seen in the septic deliria. Harmsen, Maass and Robert liken the postmortem findings to those of phosphorous poisoning. Thus, the normal liver contains from 8 to 25 per cent of fat, that of phosphorus and of alcohol poisoning 50 to 70 per cent and that of Amanita-toxin (2 cases) 53 and 69 per cent. Death seems to be due to this extreme fatty degeneration of the liver. (Ford, Schuerer.) Medico-legally, such a liver, with the addition of the other findings, makes the postmortem picture pathognomonic of *Amanita phalloides*.[10]

Treatment of Poisoning by *A. phalloides*

All authorities agree unanimously that therapeutic measures in these grave emergencies are almost useless. Case histories show that often the cause is not recognized, or the gravity of the cases not appreciated. There is no antidotal drug for Amanita-toxin and the treatment is that of poisoning and septic intoxication in general. Competent medical advice should be obtained as soon as possible. Active emetics (ipecac, mustard, apomorphine), assisted perhaps by the stomach-tube, purgatives (castor oil being preferable to the salines) should be administered at once and every effort thereby made to reduce further absorption of the poison to a minimum. By the time symptoms from *A. phalloides* have begun, the toxin is already in the circulation. High enemata to empty the lower bowel may be used early. Later normal saline solution should be given thus, or hypodermically, or even intravenously to supply the body's need for fluid and to ease the torturing thirst. Narcotics and anodynes in large doses are necessary to relieve the intense pain and to quiet convulsive movements. Nitroglycerine and strychnia frequently, and up to the limit of tolerance, are of great value. Cyanosis calls for oxygen inhalations. Atropine may be of use as a stimulant and a corrective with morphine *but it has no antidotal value here*. Milk, raw or boiled, may be regarded as a mild natural antidote.[18] Alcohol should probably not be given in any form. Strong coffee is indicated as are hot dry applications to the body. Digitalis may be used but requires from six to ten hours before effects are seen. Camphor[10, 30] in sterile oil given subcutaneously every hour is valuable. Suprarenal extract is mentioned. Large draughts of hot water, flaxseed tea, slippery elm or starch water[14] may be used, as well as tannigen, bismuth subcarbonate and opium to quiet excessive diarrhea and vomiting. Supportive measures and good nursing are of the greatest importance. Transfusion of blood would seem worthy of trial in graver, slower cases.

Ford, finding that protective and curative sera were theoretically possible, worked for three years on the serum-therapy. He was able to immunize animals to the aqueous extract up to five or six times the fatal dose[15] but efforts to manufacture a curative serum have thus far been unsuccessful.

The Fochier treatment by abscess of fixation[53] has been applied by Dr. A. Pic of the University of Lyon in 23 cases of which 9 died. The conclusion that "it is a

therapeutic agent of the first order in those terrible intoxications due to *Amanita phalloide*s" seems to have made no impression on the medical profession. Judging from Michigan cases—37 illnesses with 16 deaths—this is not a remarkably low mortality, 39 per cent versus 42. Pic and Martin contrast it with "the usual 86.8," based on 38 cases with 33 fatalities in France, 1913.

Poisonous Constituents of *Amanita phalloides*

The first attempt to obtain the active principle or poison of *A. phalloides* is probably that of Letellier, who in 1826 obtained a heat-resistant substance from a number of fungi. This was termed amanitin. Later he found two substances, one of an irritating nature, acting upon the mucous membranes of the alimentary canal and another characterized as a glucosidal alkaloid—the Amanitia. Boudier in 1866 ascribed the poisonous action to an alkaloid which he named bulbosine, but was never able to isolate. In 1877 Oré concluded, on biological grounds alone, that *Amanita phalloides* must contain an alkaloid and this hypothetical poison he named phalloidin. These names are no longer employed. Kobert (1891) established the important fact that extracts of *A. phalloides* contain, a substance which lakes or dissolves the red blood corpuscles of many animals and of man. With this "hemolysin" we shall have much to do in the remainder of this paper. Ford and his co-workers have investigated it most satisfactorily in their epoch-making labors which have been fully reported. This hemolysin is not the active principle—for we shall see that it is very easily destroyed by heat, much less than is usually employed in cooking, and that the digestive juices break it up as a rule. Furthermore, individuals dying of *A. phalloides* intoxication do not show symptoms which are to be ascribed to this kind of poison. Kobert gave this blood-dissolving hemolysin the name of phallin, regarded it as the essential poison, and gave it undeserved importance. He placed it in the group of protein-like poisons known as toxalbumins because of its susceptibility to destruction by heat. Beside the hemolysin, and more constantly present, Kobert found later an alcohol-soluble substance which was extremely poisonous to animals. This he regarded (1900) as an alkaloid, soluble in alcohol, which would not produce fatty degenerations. A toxalbumin (near thujon and pulegon), was held responsible for these.

Frey,[16] in 1912, comments, "The whole study of mushroom poisoning still lies very much in the dark. It is on the same plane as thirty years ago." He says that studies on muscarin and phallin show old results and theories to be wrong, but otherwise there is no progress. The publication of results of recent American investigators seems to have been unknown to him, for progress has been made, and a basis for further results established. Murrill[17] comments (1910) that it is remarkable how little is really known, and that the practical importance of the subject is vastly increasing. The important work of recent American investigators began with the proof (Ford18) that extracts of *Amanita phalloides* contain the hemolytic material described by Kobert and in addition a heat-resistant body which will reproduce in animals the majority of the lesions described in fatal cases of *A. phalloides* intoxication in man. These two substances were named by him the Amanita-hemolysin and the Amanita-toxin. The further chemical study upon the plant was carried out by Abel and Ford,[19] by Schlesinger and Ford,[20] and Ford and Prouty.[21] In these papers it was shown that the hemolytic agent is not proteid (toxalbumin) but an easily-decomposed glucoside, insoluble in alcohol, extremely sensitive to heat, to small traces of acid, to pepsin and pancreatin, and that it can therefore play no role in poisoning in man when the fungi are cooked. It may be a factor if large quantities are eaten raw or insufficiently cooked, or if through deranged digestive action the hemolysin escapes destruction.[15] It is present in such great amount that under such circumstances the possibility of its having a poisonous action cannot be eliminated. The Amanita-toxin has so little in common with alkaloids that they hesitate to class it with them.[15] Amanita-toxin is the alcohol-soluble active principle, *the essential poison*, resisting the action of heat, of drying and of the digestive juices, and reproduces in animals the lesions found in *phalloides* intoxication in man. Chemically it cannot be characterized definitely, but the purest preparations do not give the reactions of either proteins, glucosides or alkaloids. Rabbits are not affected by various extracts by mouth, both the hemolysin and Amanita-toxin being quite innocuous to them, when one-fortieth of the amount was fatal when given subcutaneously. Dogs and cats are poisoned by the cooked fungus in the same degree as human beings. The raw hemolysin given subcutaneously has pronounced blood-dissolving properties, giving the picture of a hemolytic intoxication with extreme haemaglobinuria and pigmentation of the spleen.[13] [These are the properties assigned to the European *Helvella* (*Gyromitra*) *esculenta*.] Even when made from dried specimens of *Amanita phalloides* hemolysin will dissolve the red blood cells of guinea pigs, rabbits, fowls, pigeons, dogs, goats and man. Swine, sheep and beef bloods are not susceptible. The blood of the guinea pig is most susceptible and that of the goat least. When this hemolysin is heated to 140° F. it loses some of its activity, and 150° maintained for one-half hour, suspends it. (Hence the term "thermo-labile.") It may be classed with the bacterial hemolysins. Injection experiments on animals show its extreme toxicity. Within a few hours the fur ruffles and they refuse to eat. There is rapid loss of weight and strength, death occurring within one to three days under great dyspnoea. The heart stops last. In smaller doses a chronic intoxication is produced lasting three, four or six weeks. Convulsions are unusual and there is no salivation or gastro-intestinal disturbance—in contrast to muscarin poisoning.[18] Frequently, even in *A. phalloides*, the hemolysin is present only in small amounts and it may be absent whereas the edible *A. solitaria* and *A. rubescens* contain it in great abundance. "It is probably a food and certainly harmless,"[3] i. e., when cooked and eaten by man.

The Amanita-toxin is the more active and acutely fatal, producing approximately the lesions seen in man from the whole cooked plant, ulcers in the stomach and intestine, serious hemorrhages, and in other organs, especially liver and kidney, cell necrosis and fatty degeneration.[13] It loses potency somewhat but not greatly on boiling. In a later report[31] Ford and Brush say that *Amanita phalloides* var. *citrina* gathered in France corresponds in all particulars to the *A. phalloides* gathered in America, and has identical properties and contains the same poisonous substances.

OTHER AMANITAS

Amanita verna and *A. virosa* have been already mentioned as included in the above section. *A. spreta* is recognized to be deadly poisonous. A group in which Amanita-toxin is present in small quantities includes *A. porphyria*, *strobiliformis*, *radicata*, *chlorinosma*, *mappa*, *morrisii*, *citrina*, and *crenulata*. The first four of this latter group are devoid of haemolysins but owe their toxicity to small amounts of Amanita-toxin. In *A. spreta* the hemolysin is small. The extract caused both acute and chronic intoxication in guinea pigs but not in rabbits. Poisonous, Boston Mycological Club, and Atkinson.

Ford and Sherrick[41] found in *Amanita mappa* a small amount of thermo-labile hemolysin, a chronic intoxication of guinea pigs closely resembling that of *Amanita phalloides*. No muscarin. Rabe says *A. mappa* has the same poisons as *A. phalloides* but in much smaller amount. It should be classed as perhaps less dangerous than *A. phalloides*. Other Amanitas may be grouped here by Ford's reports.[22] The agglutinin will receive attention in the account of *Amanita muscaria*. The chronic intoxication is shown by a progressive emaciation and death in 18 to 20 days.

Amanita citrina (of Europe) a yellow variety of *A phalloides* (Robert). No hemolysin or agglutinin. Poisonous to guinea pigs and rabbits by both acute and chronic intoxication. Seldom, if ever, toxic to man.[18] A distinct species from *Amanita phalloides* var. *citrina*.

Amanita crenulata—No hemolysin or agglutinin. Chronic intoxication in guinea pigs and rabbits. Extract made after one year of drying was fatal by chronic action after an acute. Poison, small in amount, similar to Amanita-toxin. McIlvaine records it as edible.

A. morrisii—Small amount of hemolysin destroyed at 60° C. Poisonous to guinea pigs and rabbits. Should be grouped with the deadly species. Edibility not tested.

A. chlorinosma is probably seriously poisonous. *A. strobiliformis* acts like *phalloides* on frog's heart.

The species of the genus *Amanitopsis* as a whole are regarded as edible. McIlvaine warns against confusing *A. spreta* with these species.

Amanitopsis volvata may be grouped with *phalloides*. No hemolysin or agglutinin, fatal in 7 to 22 days to guinea pigs and rabbits, the intoxication resembling Amanitas. McIlvaine pronounces it edible, but it should be avoided. *Amanitopsis vaginata* is easily learned and is edible.

Amanita junquillea—rare and unimportant—free from poisonous properties.

Amanita solitaria—difficult to recognize. Contains small amount of hemolysin. Edible, McIlvaine. Ford[32] reports it almost free from poisonous action on rabbits and guinea pigs, but large doses produced a salivation in the latter. *Muscarin is more widely distributed in fungi than was originally supposed*.

Amanita rubescens—commonly known as "The Blusher," Red Amanita. Non-toxic to animals and man. Free from Amanita-toxin but has a powerful hemolysin. European authorities differ but our American form is a well-known edible species.

Amanita frostiana—difficult to identify, is closely related *botanically* to *A. muscaria*, of which it has been regarded as a small or depauperate form. It contains a small amount of a thermo-labile hemolysin, but no muscarin. Its extracts have no effect on animals. Not tested but probably edible.[22] CAUTION! lest *A. muscaria* be used.

AMANITA MUSCARIA

Amanita muscaria, the Fly Agaric, is a most interesting fungus. It is also called "the false orange" and "Fliegen Schwamm." It is less common and less toxic than the group of *A. phalloides* but is widely distributed over the world. In importance it ranks next to the white Amanitas. It is subject to great variations in color, size and markings, but is easily learned so that it may be distinguished from the famous edible *Amanita caesarea*. Ford [3, 18] and Michael and others agree that its taste is bitter and unpleasant and this factor may save people from serious accident. Occasionally the bitter taste is absent, more is eaten and quick fatality may result.

Through the publication[23] of Circular No. 13, U. S. Dept. of Agriculture and of Prentiss' account[24] the fatal poisoning of Count de Vecchii in November, 1897, has become classic. He bought from a countryman a quantity of *Amanita muscaria*, picked in Virginia, seven miles from the capital. The Count was familiar with mushrooms and took these to be the Royal Agaric, *Amanita caesarea*. At breakfast, which was finished at 8:30, he ate two dozen and pronounced the taste particularly good. Dr. K. ate one dozen. By 9 a. m. the Count was lying on his bed in a state of collapse, filled with a sense of impending death, and soon lost consciousness. Blindness came on before this, as did rigid spasm of the lower jaw, and difficulty in swallowing. Convulsions were so violent as to break down the bed. Emetics were given and apomorphine and atropine subcutaneously. He became continually worse and died without regaining consciousness on the evening of the next day. Dr. K. went by car to his office. While sitting on a chair, about 9 a. m., he gradually passed into unconsciousness without feeling any premonitory pain or

distress, though half-stupid and very restless just before. He noted, about 9:10, uncertain eyesight and double vision, without nausea. A prominent early symptom was sudden jerking back of the head. He remained unconscious for five hours; at one time his life was almost despaired of. He did not suffer the least pain but on the contrary was in a comfortable dreamy state. By 7 p. m. he was out of danger. Cold sweats were a prominent symptom. A total of one-tenth grain of atropine was given in 24 hours. Apomorphine produced no emesis, vomiting not occurring until evening. Castor oil and sweet oil were given about noon.

THE CLINICAL FEATURES of poisoning by *Amanita muscaria* are quite as characteristic and distinctive as those in *Amanita phalloides* intoxication and should enable physicians to distinguish clearly between the two conditions—when either fungus is eaten alone. So often a mixed lot of different varieties is used that the symptoms in patients point to the combined action of different toxic principles. In *A. muscaria* poisoning there is usually a very short interval between ingestion and first symptoms, one-half to one hour or at most three hours. If small amounts are eaten even five or six hours may elapse. This feature is of greatest value in deciding upon the kind of intoxication which the cases present. Severe ones show excessive salivation and perspiration, a flow of tears, a feeling of laryngeal constriction, nausea, retching, vomiting and watery diarrhea. The last named almost always occur. The pulse is usually slow and irregular. There is no fever; pupils are small. Respirations are accelerated and the patients clyspnoeic, the bronchii being filled with mucus. (The action of atropine is the opposite of this, point for point.) Mental symptoms are also present, particularly giddiness with confusion of ideas and rarely hallucinations. All these symptoms may vary in intensity, at some times the gastro-intestinal predominating, and at other times the mental. In light cases only salivation or perspiration may be noticed, with uneasiness in stomach and bowels, for a few hours. In severe cases the vomiting and diarrhea may rapidly rid the alimentary canal of the offending material and the nervous symptoms then become predominant—delirium, violent convulsions and loss of consciousness developing in rapid succession and the patient's sinking into a deep coma. Rarely, consciousness is retained till the end, death resulting from paralysis of the respiration. Finally, in many cases, after the vomiting and diarrhea, the patients sink into a deep sleep, awakening later profoundly prostrated but on the road to recovery. Normal health reappears rapidly—two or three days. There are no late effects in *muscaria* intoxication as in that of *Amanita phalloides* with its degenerative changes in the internal organs. The prognosis is always good if the patient recovers from the preliminary symptoms. When, rarely, the nervous symptoms dominate the alimentary, excitement and hallucinations simulate alcoholic intoxication. (Quoted freely from Ford and Clark.[25]) The delirium is occasionally followed by loss or impairment of memory. The pupils dilate as death approaches. The action of muscarin is almost identical with that of pilocarpin.

Post-mortem examination reveals surprisingly little. The pathology of *Amanita phalloides* is absent, particularly the lesions of the liver. In general the findings point to the action of a profound nerve poison.[3] Medico-legally, remains of fungi in the alimentary canal would be of great importance.

Poisonous Constituents of *Amanita muscaria*

Schmiedeberg and Koppe, in 1869, showed by the most careful work, both chemical and pharmacological, that *Amanita muscaria* contains an active principle which they called muscarin. At first regarded as an alkaloid of the same general nature as strychnine and morphine, later work has shown that it is probably a complex ammonia derivative. Muscarin is an extremely active substance, well known from the attention it has received in all works on toxicology and materia medica and therapeutics. In the latter field it can well be spared on account of its variability and unreliability and because we have better drugs of similar action. Muscarin is near pilocarpin and nicotine in action, exciting smooth muscle and stimulating all glands. At almost every point in its action it is the direct antagonist of atropine (from belladonna) but is far less powerful. It is present in the fungus in but small amounts but is nevertheless able to exert its characteristic effects, frequently with fatal outcome. In producing paralysis of heart and respiration it does so by stimulating the inhibitory nerve endings of the vagus. Atropin has a depressing action upon the same nerves which muscarin stimulates. The muscarin excitement, remarkably, does not pass over into a paraylsis, its curare action (that of arrow-poison) being slight. Muscarin has been synthetically prepared by the oxidation of cholin but does not keep as well as the natural product, and differs materially in its action upon animals.[18] A ptomaine muscarin is also known.

But poisoning by *Amanita muscaria* and muscarin poisoning are by no means identical (Harmssen[26]). Robert says the fly-agaric drunk (Fliegenschwamm Rausch) is by no means a pure muscarin "jag" but resembles haschisch (*Cannabis indica*). Harmsen found that he could extract from 100 g. of fresh *muscaria* 16 mg. of a fairly pure muscarin. This was twice as deadly to cats as to frogs. That it is not the sole factor in poisoning is shown from the following: (1) with the lethal dose of muscarin at 0.525 g., it would require 4 kg. (8.8 lbs.) of the fresh fly-fungus to produce a fatal outcome26; (2) when the action of the muscarin-part of an entire extract is physiologically neutralized by atropin, the animals nevertheless die; (3) the extract is deadly even when the muscarin is removed. He has also shown[26a] that the entire extracts of *A. muscaria* are twice as toxic, weight for weight, as pure muscarin and contain a poison which produces in animals continued convulsions with fatal outcome, not prevented by atropin. He therefore assumes the presence of at least one other substance which he names "Pilz-toxin." This pilz-toxin must be .very unstable since it loses potency on drying,

and is sensitive to heat (thermolabile). It does not appear in the urine. (Compare intoxication of the Koraks.) His work casts doubt over the value of atropin as an antidote and is in accord with clinical experience. In 1910 Ford[22] said *Amanita muscaria* acts in all animal experiments as a convulsant and no other agaric shows similar action, not even the closely related *A. frostiana*.

Treatment for *Amanita muscaria* Poisoning

Just as in cases of *A. phalloides* intoxication, it is the important duty of physician and friends to get all the information possible as to the exact nature of the toadstool eaten and the amount ingested. *It will be shown below that a number of species of fungi; mildly tome or simply deleterious and unwholesome, can produce a more or less typical picture of muscarin intoxication*. Confirmation of the species will therefore be of great value in determining prognosis and in giving a clew to antidotal treatment. The outlook in poisoning by the fly agaric is more hopeful than when the Destroying Angel (*A. phalloides*) has been ingested, the mortality runs much lower, the illness is briefer and the suffering less cruel—though bad enough. We do not have here the chronic and degenerative lesions produced by the white Amanita which defer death or prolong convalescence. The *muscaria* intoxication is acute, comes on soon after eating the fungus, develops rapidly and is amenable to treatment. Recovery often occurs without untoward symptoms. Lachrymation, salivation, contracted pupils, delirium, hallucinations, and coma call for atropin in large doses subcutaneously or intravenously. Even though the vomiting and diarrhea are pronounced, the stomach and bowels should be further emptied by the free use of emetics and purgatives, for parts of the fungus are often found in the canal post-mortem when profuse emptying seemed to have taken place. On account of coma, apomorphine subcutaneously is less apt to work, and other means of emptying the stomach should be begun early (stomach tube, mustard, zinc sulphate, sulphate of copper). In cases with bad heart action, respiratory distress and coma, atropin (intravenously) offers the only hope, though many other measures, as mentioned under *A. phalloides* treatment, should not be neglected. Absolute recumbent rest is enjoined. Sustain the heart. Give nitroglycerin for cold skin and extremities, and dry heat.[24] Atropin is not medically indicated in every case, and good nursing may easily be of greater importance to tide over periods of weakness and depression. Nourishment should be concentrated. Tannic acid is useless; acidulated water bad. Transfusion of blood, oxygen and galvanism, have been suggested.

The fly Amanita possesses interest in several other respects. It is eaten in the Erzgebirge of Saxony and Bohemia.[11] Treated and untreated it has been eaten without bad results. A colored woman in Washington recited in detail how she was in the habit of cooking it. Rejecting gills and peeling the cap, specimens were boiled in salt water and then steeped in vinegar, then washed and cooked and served with steak, the whole process a rational process to remove poisons (?). Michael[27] worked up to eating a thick medium-sized cap (cooked) and "properly peeled." It tasted ill but did no harm. Then he ate a specimen prepared as salad which tasted worse. On this ground he classes it as "inedible." For reasons like this we are loath to take any one man's testimony in the great field of mycophagy. Peck has repeatedly received reports from various people who eat it.[54] He also records the eating of the fine variety *formosa* of *A. muscaria* by a sheep, but Ford[22] suggests that the herbivora are (at least, by mouth) immune to this toxin as well as to others. There seem to be *seasonable and local variations in the toxicity of Amanita muscaria*[55] *and of other species*.

One-tenth of a raw *A. muscaria* has produced in a man of thirty-seven years, eleven days of illness, with typical *muscaria* symptoms, but accompanied by fever.[56]

The use of *Amanita muscaria* simply and purely for producing drunkenness is well known, but has not been satisfactorily explained. Krasheninnikoff, who travelled in Siberia and Kamchatka for ten years (1733), reports that the Koraks used the fly Amanita—three or four for a moderate dose, and ten for a thorough drunk. Langsdorff (1803) confirms this and Kennan[28] describes it in some detail in his first Siberian journey. The natives call the fungus "muk-a-moor." Its sale has been made a penal offense by Russian law but "prohibition does not prohibit." One fungus may sell for $20 worth of furs, and supply does not equal demand. The dried cap is used; a duly flavored decoction is made from them or pieces are swallowed whole. First effects come on rapidly and make the candidate cheerful and merry, then drowsy and sleepy for ten or twelve hours and he awakes in a state of exhaustion. During the stage of excitement there is a horrible kind of delirium and the experience of visions of varied character. The intoxication is prolonged or passed on (among the lowest and most degraded Koraks) by drinking the renal excretion and thus a spree may be economically kept up for a week.[24] Evidently the muscarin is excreted unchanged. (See Ziemssen, Fungus Poisoning, Vol. 17.) Toleration develops, though death from an orgy is not uncommon. The meat of animals dead of muscarin poisoning has a pronounced poisonous action if eaten by others (Stellar & Erman). In regard to the use of *Amanita muscaria* as a fly poison, D. R. Sumstine (Penn.) reports that the apparently dead flies revive fully in about two hours. One of our mycologists has seen them recover after two days. Tappeiner[30] states that the fly poison is easily destroyed.

Toxic Principles of Amanitas

Harmsen's "Pilz-toxin" was never confirmed. Ford[22] agrees that *A. muscaria* owes its action to muscarin but in place of the second poison hypothecated by Harmsen it contains also an hemolysin (as in *A. phalloides*) soluble in alcohol and *a constantly-present agglutinin* belonging to the glucosides. Agglutinins are bodies capable of causing groupings, coherence or agglutination of blood corpuscles when brought in contact with them. They act directly on the blood cells.

Given subcutaneously the agglutinin of *muscaria* always caused death in typical convulsions. Violent cooking of the plant, deadly without boiling, was shown to destroy both the muscarin and agglutinin. Subsequent studies of other fungi were based upon a search for the actions of the four active agents thus far enumerated. We have seen from the foregoing consideration of two deadly toadstools that *Amanita phalloides* contains two poisons, (1) an hemolysin which is thermolabile and also easily destroyed by the digestive juices and (2) an Amanita-toxin which is the very definite and powerful poison of the species. Now in *Amanita muscaria* we have (1) muscarin, a poison with its characteristic and individual physiological action, (2) hemolysin in small amount and (3) an agglutinin. Agglutinins are not common in plants. Out of ninety-nine examined they were present in four non-poisonous Papillionaceae and in six Daturas. Among 40 fungi they were present in one-quarter, thermolabile in some, in others heat-resistant. They resisted drying of the fungi better than did the hemolysins and were found to last for years in dried *A. muscaria*.[22]

Amanita pantherina, though rare or lacking in America, may be associated with *A. muscaria* since it is said to be used in Japan to produce mushroom drunkenness. Muscarin has been isolated from it as from the Siberian fungus. Delirium, dilated pupils and hallucinations with visions of beautiful red, yellow and brown objects predominate over the gastro-intestinal symptoms. *A. pantherina* is also used as a fly poison. Poisoning from it shows the usual alimentary irritation coming on within a few hours, great excitement, delirium and convulsive seizures. Ocular symptoms, loss of memory and syncope are frequent. Gillot has collected thirty cases with two deaths and Inoko, in Japan, a series of thirty-two with one fatality. Recovery is usually rapid but occasionally convalescence requires fourteen days. Atkinson's *Amanita cothurnata* may be the American representative of *A. pantherina*, hence both of these should be avoided as esculents. *A. cothurnata* will poison flies. *A. pantherina* extracts were without effect on animals but only a few plants were tested.[41]

There has been in recent years a tendency to explain away too many cases of minor poisoning as due to indigestion, decomposition of the abundant proteid of mushrooms, or to the possible insect-infection of good fungi—and to refer too many of the cases to "probably *phalloides* or *muscaria*." Now the rich labors of Ford and his co-workers, both in the field and in the laboratory, and the results of Clark, Smith and Kantor have verified certain clinical experiences and shown us that the list of more or less poisonous species must be considerably extended. *Amanita phalloides* and its few congenors still stand quite alone, head and shoulders above all others, for extreme toxicity. They are, most fortunately, not likely to have any rivals for dangerous qualities. They have retained their place easily at the head of the list of noxious species, but the minor and less poisonous list has been somewhat increased. These nearly all belong, in a way, to a *muscaria* group. It will be the problem of pharmacological and biologic chemistry to show why they cause such a variety of clinical disturbances,—by no means explainable by "indigestion,"—and yet resemble the action of muscarin.

THE GENUS LEPIOTA

In contrast to the genus Amanita with its very dangerous species and its few safe edible forms we have in the equally large genus Lepiota a number of highly prized edibles. Amanita requires close discrimination to distinguish its species; Lepiota, for the mycophogist, principally, that he shall not confuse its *L. naucina* with *Amanita phalloides* and that he shall not mistake the black sheep of the section, *Lepiota morgani* or green-spored Lepiota for *Lepiota procera*, "The Parasol." *L. morgani* is an enticing plant and probably the largest Agaric in the world. It is distinctly American. This fine fungus shows very consistent partiality in selecting its victims for it always poisons certain individuals who try to eat it and never distresses others of the same family. It is credited with at least one death and many serious illnesses. Significant it is that heating destroys the greater part of its toxic properties.

Dr. Blount (Illinois) says[33]: "One day last month the Man of Science of our house came home with a fine specimen of large white mushroom which he took to the library and identified as 'horse mushroom.'" (If you do not care to discriminate between white-spored and purple-brown-spored Agarics, mycophagy is a dangerous field for you!) "So a few were collected and prepared for dinner. The Man of Science ate a small piece raw at 2 p. m. At 5 p. m., feeling well, he tried another piece, raw, as large as the little finger. At 6 p. m. he felt generally ill and ate no supper. In half an hour he began to have profuse, painless watery bowel movements, but blamed a dentist and his drugs for this." Dr. B. took two small portions each as large as a pea about 6 p. m. The after-taste created loathing. Discomfort was immediate, and consisted of a warm heavy sensation, slight pharyngeal spasm and difficulty of swallowing. By 7 p. m. vomiting had begun, became very violent and continued every five to ten minutes. Diarrhea began and lasted all of the next day. Intense burning pain in the stomach alternated with intervals of lassitude and exhaustion.

At 9 p. m. hypodermic medication (strychnia 1/30, atropine 1/100, morph. sulph. 1/4) and cocaine produced relief and slumber came on at 11 p. m. Pulse was weak and rapid; perspiration free. The Man of Science vomited three times and had diarrhea all night. He felt as usual the next day. He ate most and suffered least. The action of the poison suggests muscarin.

V. K. Chestnut[34] records that the president of the Chicago Mycological Society mistook *L. morgani* for *L. procera*. Prof. Miller (Terre Haute) eats *L. morgani* and tells of six families that do so. One or two members of each family are made sick, though two families have eaten it repeatedly without trouble resulting. "The meat

is simply delicious." Galveston and Milwaukee record seven cases of illness and V. K. Chestnut adds twenty beside. Detroit might add four. The symptoms are as above described, apparently also from cooked specimens. The fatal case was that of a two-year old child who died in convulsions in seventeen hours after eating of a raw plant. Poisoning has resulted after every variety of cooking and after soaking in salt water. Webster[35] tells of a New England mycophagist who removed to Missouri, identified *L. morgani* as *L. procera* from pictures (!) and paid the penalty within two hours. He draws the moral, "*Eat only what you KNOW!*" McIlvain[38] (p. 711) reports another case from Wisconsin of violent illness from raw (?) *L. morgani*, mistaken for *L. procera* and eaten in very small amount, presenting all symptoms above recorded but with the addition of temporary blindness. Warren (Port Huron) records that in a family of five who ate it two girls were made ill. Symptoms came on early the next morning—seven hours after eating—and were "almost as bad as from Gyromitra poisoning as it is known in Port Huron."

THE GENUS TRICEOLOMA

In this genus McIlvaine agrees to label *T. saponaceum* and *T. sulfureum* as inedible on account of taste. I had for years regarded the entire genus as safe, but in August, 1908, we had a group of seven cases of rather violent poisoning from an innocent-appearing Tricholoma. Good specimens were at once sent to Atkinson who described them as a new species which he named *Tricholoma venenatum*. This agaric has not been found again nor further tested. Of the lot eaten many were badly infested by insects when examined two days later. The symptoms came on one hour after supper and consisted of vomiting, sometimes bloody, retching and considerable prostration in three individuals. All recovered. Surprises like this will continue to occur as long as fungi are eaten. It may be years after some varieties of poisoning occur before the etiology is satisfactorily settled: whether due to a new deleterious species; a known inedible variety not recognized by the consumer; a personal physiologic sensitiveness of the individual; decayed fungi of good species or some infested by acrid insects; the rare presence of a minor toxin in some generally-esteemed edible variety; or simple acute indigestion—perhaps due to gluttony. The observer should endeavor to fix positively the responsibility on the one real cause.

THE GENUS CLITOCYBE

Like Lepiota, this large genus has for years been credited with but one deleterious species. Within a few years two others have been added. All three show muscarin symptoms in variety.

Clitocybe illudens, known as the "Jack o' Lantern" because of its phosphorescent glow, or the "Deceiving Clitocybe," is mistaken every year, in Detroit, by our foreign residents for *Armillaria mellea* or for the European Chanterelle. And on such annual fall occasions it holds high carnival and breaks into the newspapers. The attending physician has a busy night or a few busy hours—and is credited in the daily press with having saved lives in toadstool poisoning. The mycological investigators visit the family and usually find its members up and about their usual occupations. This is the impression one gets of *Clitocybe illudens* from twenty-nine Detroit cases. The remnants of the feast are usually found to be large half-cooked tough masses. McIlvaine reports a saponaceous taste—and the ability to retain the fungus when eaten. It is possible to make it comparatively harmless by heating it in salt water for half-hour, then taking it out and frying it in butter.[39] Farlow[36] reports illness of four persons. They found the fried flavor excellent. Within two hours all had free vomiting lasting all afternoon, no depression, no intestinal disturbance. No emetics were used since the Jack o' Lantern carries this property with it and may thus ward off more serious results. At a New York state institution eight teachers and children, after terrible nausea, recovered. No fatalities have been recorded. Diarrhea and prostration may occur. Clark and Smith[37] found that extracts of the plant would stop a frog's heart which would recover under atropine. Similar results were obtained on the creature when paralyzed by the extract. They conclude that Clitocybe illudens exerts a characteristic muscarin effect on exposed hearts which effect is completely overcome by atropin. (Not the case in extracts of *Amanita muscaria*.) Ford finds no hemolysin but the power to produce an acute intoxication in guinea pigs, fatal in one to seven days or a chronic intoxication lasting fifteen days. No lesions postmortem. Rabbits unaffected. After one year of drying boiling for half-hour destroyed the toxicity.

The characteristic American *Clitocybe illudens* has its phosphorescent and related European correspondent in *Agaricus* (or *Pleurotus*) *olearius*, which, mistaken for the Chanterelle, caused illness of the *illudens* type in France.[44]

Fabre writes, "The soft light of *Agaricus olearius* has confounded our ideas of optics; it does not reflect, it does not form an image when passed through a lens, it does not affect ordinary photographic plates." (Fabre, Poet of Science—LeGros.)

Clitocybe dealbata var. *sudorifica* or *Clitocybe sudorifica*, the sudorific Clitocybe, is an interesting little toxic toadstool recently added to the black list. It is often found among "fairy rings" (*Marasmius oreades*). I believe it has been picked with the latter and thus caused trouble, though easily distinguished. The flavor is good. Minneapolis has a record of two cases of poisoning. Peck himself tested it, eating eight caps slightly fried, and got the usual reaction, i. e., some five hours of profuse perspiration beginning on the forehead and spreading over the body. This may be attended by increased nasal and salivary secretion, hiccough and discomfort, though there are no other ill effects. The original lot was tested on animals.[40,41] In a rabbit the watery extract produces profuse salivation in a few

minutes with weakness and sickness, increased renal activity and activity of the bowels, followed by gradual improvement. Fatal to guinea pig in one quarter hour. Even the boiled extract paralyzed the respiration in seven minutes. Autopsy negative. One rabbit died with slightly contracted pupils. In a third guinea pig there was salivation, lachrymation, etc., increased respiration and then respiratory paralysis. Drops in the eye contracted the pupil for four hours. Its action therefore is that of the muscarin-pilocarpin series. The little Clitocybe seemed more poisonous than *muscaria* extract tested side by side with it for it killed rabbits that withstood larger doses of *muscaria* extract. A frog's heart could be stopped for one hour with it and then revived with atropine. *Clitocybe dealbata* should likewise be avoided for *C. sudorifica* has been mistaken for it by a well-trained mycologist.

Clitocybe morbifera is similar in habitat and appearance to the preceding and is closely related to it.[42] In four cases in Middleville, Michigan, which have come to my attention, the symptoms were more severe and serious than those of *C. sudorifica*. There was more discomfort and the attending physician recognized the likeness of the clinical picture to muscarin disturbance and used atropine. Four people ate, and three were made ill. The one that suffered most had over-taxed her digestive powers the day before—a factor that seems to predispose to mushroom poisoning. Symptoms came on two hours after eating and were abdominal pain, vomiting of food including entire specimens of tough "Fairy Ring" fungi, purging, sweating, cold extremities and collapse. In one case there was some blindness. All were fairly well the next day. Animal tests have not been made. These must henceforth be regarded as a necessary part of the record.

Clitocybe nebularis which made Cordier ill, and is reported as poisonous when raw (Bertillon), is legally allowed among the thirty varieties permitted in the markets of Munich.[11] Here legal enactments, duly enforced, have reduced the number of poisoning cases.

THE GENUS HYGROPHORUS

Experimentally in man no Hygrophorus is known to be inedible and there are many fine esculents. *Hygrophorus conicus* used to be forbidden and Demange has attributed a serious outbreak of poisoning to it. It is fatal to guinea pigs by chronic intoxication—as are many perfectly safe fungi. Cooke and McIlvaine say it is all right. *H. pratensis* var. *cinereus* is toxic to guinea pigs.[22] It is edible. Var. *albus* contained a heat-resistant agglutinin and hemolysin: toxic to guinea pigs. Edible. *H. marginatus* similar and edible. See Bibliography, reference 22, for several others. The genus is either devoid of action or poisonous by chronic intoxication only to guinea pigs. An excellent record, so far. The species are clean, beautiful and inviting.

THE GENUS LACTARIUS

Lactarius contains some well known edible mushrooms—*L. deliciosus*, *volemus*, *corrugis*, being well liked. McIlvaine says that not a single species retains its pepperiness after cooking. Some of the genus tasted raw are horrible. *L. torminosus* "the griping milky," is charged with having caused fatal illness.[45] In Germany it is known as the "Birken"—or "Gift-reizker." Eleven were poisoned. Three children ate it fried, the youngest, aged two, died in twenty-four hours. Eight Polish laborers, including two women who ate most, prepared it. The women died after six day's illness, treatment coming late in their case. Symptoms came on in about five hours and consisted of nausea, headache, abdominal cramps, vomiting prolonged and even bloody; diarrhea was synchronous, violent and profuse and accompanied by tenesmus. Anuria and albuminuria followed. Skin dry and later jaundiced; pupils dilated; heart negative but weakening; respiration rapid, shallow, irregular and finally Cheyne-Stokes. Temperature normal. Liver somewhat enlarged. The remainder of the description, as well as the postmortem findings in the adults, suggests very strongly that *A. phalloides* was the cause and not *L. torminosus*. Atropin proved without effect in the therapy and the invaluable hypodermoclysis of normal saline solution was not used. No account of why or how *L. torminosus* was settled upon as the cause is given. Hockanf[11] doubts the diagnosis and says many authors (six are named) say *L. torminosus* is harmless when cooked. Krombolz has eaten it though the taste was bad. Huseman's two cases referred to the species fit *Amanita muscaria*. Great mycologists give conflicting reports. Kunkel says in Sweden it is used cooked and is poisonous only when raw, and this agrees with Ford's results.[22]—Ford found that its hemolysin and agglutinin were destined at 150° F. Though acutely fatal to both guinea pigs and rabbits which showed convulsive-like movements, with retraction of the head—a little like *A. muscaria* intoxication but with more somnolence—these toxic effects were not obtained when the extract was cooked one-half hour. Its safety or danger perhaps depends entirely upon the cooking. Maass[12] alludes to the presence in some fungi of drastically purgative resinous acids which may be decomposed by cooking processes and become foods. The milk of the Lactarii seems to be such a substance. "Insects eat both *L. torminosus* and *L. deliciosus*. They pronounce excellent what we find poisonous and vice versa" (Fabre). Hockauf regards *L. torminosus* and *L. zonarius* as poisonous and *L. plumbeus*, *L. chrysorrheus*, *L. vellereus*, *L. insulsus*, *L. pubescens*, *L. pyrogalus*, *L. fuliginosus* and *L. violescens* as suspicious or inedible. McIlvaine reports *L. insulsus* and *L. vellereus* as edible, as good as *L. deliciosus*. Murrill's list of forbidden mushrooms is headed by *L. rufus* and includes *L. torminosus*, *L. fuliginosus*, *L. vellereus*, *L. pyrogalus* and *L. theiogalus*—perhaps all condemned only on account of their taste when raw. Fabre's household finds *L. deliciosus* overrated, coarse and difficult to digest.

Lactarius uvidus extract was acutely poisonous to guinea pigs, fatal in forty-eight hours, but had no effect on rabbits. No hemolysin or agglutinin. Several authors rank it poisonous; the Boston Mycological Club pronounce it deleterious. With *L. torminosus* and *Clitocybe illudens* it is ranked as a violent gastro-intestinal irritant.

THE GENUS RUSSULA

Russula, one of the most difficult genera for reliable specific distinctions, appeals to the mycophagist because of the attractiveness, tenderness and abundance of its species. Members of the Detroit Mycological Club and the Institute of Science have for years eaten all the bright colored and peppery Russulas indiscriminately and believe that *Russula emetica* is a safe fungus to eat in Michigan. Hockauf says of the European *R. emetica* which is so often condemned, that our knowledge is insufficient and that exceptions can justly be taken to reports in the literature. Krapf was made ill by it (?) before 1800 and its bad name has followed in all subsequent reports which are based on this almost exclusively. Hockauf would take reports of many bad sorts with reserve. McIlvaine is very emphatic that about all Russulas are good, even *R. emetica*, identified by Peck. *R. foetens* smells ill, tastes worse and made Krombhorz slightly ill. In 1817 ten deaths in Bohemia were credited to Russula. Murrill[7] includes *R. emetica* in his poisonous list and credits it with cholin, pilztropin and muscarin and puts down *R. foetens*, *R. nitida* and *R. fragilis* as mildy poisonous or suspicious. Warren (Port Huron) says, "I have eaten every kind of Russula I have gathered except *R. foetens* and no one would care to eat that. Never any bad effects. Greatest fault is that they are liable to be wormy. *R. vesca*, *R. virescens*, *R. cyanoxantha*, and *R. alutacea* are permitted in the Munich markets. The "fraglos giftig" *R. emetica* is eaten in the Baltic province Esthonia after parboiling. (Maass.[12])

Frey[16] says that poisoning by Russula should be classed among the greatest rarities. He reports two fatal cases, studied in the greatest detail and from every angle, with thorough autopsy. The clinical picture was not unlike that of *A. phalloides* intoxication, with gastro-intestinal symptoms dominant. The two boys that died (aged twelve and fourteen) ate the soup which they had prepared, on Sunday evening and Monday morning, were ill Monday night, attended school on Tuesday and became very ill that night, as did the father. They died on Thursday. Postmortem, the liver was not that of *A. phalloides* fatality and the gastro-intestinal hemorrhages and appearances were regarded as characteristic of the irritant action of Russula poison. It is assumed, in these two cases, that an essential change (spoiling) took place in the soup between the first and second meals. An official investigation of the abundant remnants of the fungi ruled out *A. phalloides* and placed the blame on spoiled Russula varieties.

THE GENUS MARASMIUS

Marasmius, the family of the internationally famous "fairy ring mushroom," has long been credited with having the poisonous *M. urens* and the doubtful *peronatus*. McIlvaine would clear both of suspicion. We have no data but we would again warn of the danger of getting *Clitocybe sudorifica* and *Clitocybe morbifera* cooked with *M. oreades*. The latter, moreover, has been found tough, leathery and entire in the vomited matter—after a mushroom feast—illness *ex abusu*, a common form of spurious mushroom poisoning.

Conclusions on White-Spored Genera

Of some 50 families of Agarics about 23 are white-spored. Moreover, more than half of all species one finds belong to this section. Though the most dangerous toadstools belong to the Leucosporae, there are so many fine edibles that we do not wish to discard all the white-spored species. If we are to eat fungi at all we must expect to exercise discriminating observation on every specimen intended for the table. In Amanita, the edible *A. rubescens* is no harder to distinguish from the dangerous Amanitas than are *Lepiota naucina* and many others. Mixed lots of many varieties are a menace and should be used only by the trained student who knows the qualities of each species in the collection. The number of fatalities from fungi gathered by children tells its own story. Cases among students of mycology have all been due to the milder species, and have had the saving grace of adding real discoveries or valuable information to our knowledge. If such cases are duly published a real service and a duty are rendered to science. A synopsis of white-spored species which are definitely deleterious shows: About thirteen white Amanitas and a few nearer *A. muscaria* in their physiological action; one each in Amanitopsis, Lepiota and Tricholoma; three Clitocybes; at least one (and perhaps a half-dozen) in Lactarius; Russula uncertain. Lactarius and Russula are closely related genera, and will require much more investigation, both by eating and by laboratory studies, before the properties of the species will be known. Species closely related botanically are often widely separated toxicologically, and vice versa. This is seen in the contrasting qualities of *Amanita phalloides* versus *A. solitaria* and *A. rubescens*; *A. muscaria* vs. *A. frostiana* and *A. caesarea*; *Lepiota morgani* vs. *L. procera*; *Tricholoma venenatum* vs. *T. terreum* and others; *Clitocybe illudens* vs. *C. multiceps* and others; *Clitocybe dealbata* vs. *C. sudorifica*; *Lactarius torminosus* vs. *L. vellereus* and others.

PINK-SPORED AGARICS

The number of genera is small and some mycologists would avoid eating all species of the section. The common favorite *Pluteus cervinus*, or "fawn mushroom," has caused disturbance several times, attended by numbness and tingling in the extremities, mild general

discomfort and an urticarial rash. Dr. Whetstone (Minnesota) has a record of the case of poisoning of an Iowa physician, attended by abdominal pain, nausea, and vomiting coming on three hours after eating. Cases like this should make one hesitate to recommend almost any species to the uninitiated.

THE GENUS ENTOLOMA

All species of Entoloma should be avoided by the mycophagist. They are seldom used. Warren says that you cannot cook the raw taste out of them. Vomiting, diarrhea, tenesmus, mental and physical depression are credited to them but no deaths.[22] Six species examined by Ford act identically, producing fatal chronic intoxication in guinea pigs or rabbits—sometimes in both. They vary somewhat in agglutinins and have no hemolysins. (*E. salmoneum*, *E. strictius*, *E. cuspidatum*, *E. nidorosum*, *E. rhodopolium*, *E. sinuatum* or *E. fertile*.) *E. grande* is under suspicion.[17] *E. modestum* and *E. subtruncatum* were negative.[41]

E. fertile (*sinuatum*)—1/4 oz. nearly killed W. G. Smith (Stevenson, Vol I). It "harbors a virulent poison." The genus may have its own poison, as Amanita. According to a recent collection of cases by Sartory[46] in France *E. lividum* is an extremely dangerous fungus, causing severe illness, and occasionally death. He believes that *E. lividum* is nearly as poisonous as some forms of *A. phalloides*. Butignot refers four cases of violent illness to it,[52] though but few specimens were in the mixture eaten. Vomiting and abdominal pain, sweating and a vile diarrhea were the result.

BROWN OR OCHRE-SPORED AGARICS

These are not usually regarded as poisonous.

THE GENUS PHOLIOTA

"I have nothing but praise for the entire genus." (McIlvaine.)

Recently *P. autumnalis* has arisen to claim high rank as a toxic fungus.[39] In 1911 a mother and two children ate heartily of it. The children died. Severe poisoning of three individuals is also reported from Minnesota. Animal tests by Ford and Sherrick[41] on the Minnesota lot were negative on guinea pigs, rabbits and the frog heart, but a New York lot, although negative on blood corpuscles, was acutely poisonous to guinea pigs and rabbits even after heating. Atropin did not neutralize the dilating effect on the heart. Postmortem appearances resembled those of *A. phalloides* and the extracts were quite as poisonous. It should be grouped with the deadly poisonous Agarics, with the nature of the poison unknown.[25] *P. mutabilis* is approved in Munich.

THE GENUS INOCYBE

Absolutely negligible and uninviting as food, this genus has likewise recently taken an important rank toxicologically from laboratory studies. The trouble began when Dr. Deming (once Vice-President of the New York Mycological Club) knowingly gathered *Inocybe infida* and mixed it, for cooking, with *Panaeolus papillionaceus* which he knew to be non-poisonous. The chance taken was one in a thousand—but he lost. (See 37, 47 and 48 in Bibliography.) Five people were made ill. Symptoms, which came on soon, were a sense of fullness in the head and a rapid pulse—as if nitroglycerin had been taken. Sweating and warmth, no nausea or prostration; slight confusion, pressure and pain in the lower bowel. Some patients vomited, some had diarrhea. Recovery was complete in a few hours under simple treatment. Conclusions[37,48] are that *I. infida* contains a poison of the type of muscarin, acting more particularly on the nervous system and similar to the narcotic of *Inocybe infelix*. (See below.) Atropin acts as antidote. The relationship of the toxins of *I. infida* and *I. infelix* to those of *A. muscaria* is not yet clear.

Inocybe infelix, one of the most common Inocybes, closely related to the preceding, has not been tested for edibility, nor thus far been reported as toxic to man, but its poison seems definite and powerful. Ford and Sherrick[40] found it to contain a definite poison which resists dessication and boiling. Small doses produced a deep sleep in guinea pigs and rabbits from which they awoke well. A profound acute intoxication and coma, quickly fatal, followed large doses. The intoxication was such as is seen only with *Lactarius torminosus*, a somnolence with retracted head (rabbits), passing off in five hours. The action was not characteristically that of *A. muscaria*, though not inconsistent with muscarin, but that of a narcotic of some sort. Further work is promised. Autopsy on guinea pig showed hemorrhagic spots and perforating gastric ulcer. Generally the examination was negative. *Inocybe decipiens* has likewise no clinical record. Though its agglutinin is destroyed by heat, the heated extract in 2 to 4 cc. doses nevertheless kills guinea pigs acutely—even in 20 minutes—due to dilated heart. Smaller doses bring on lachrymation, salivation and nasal discharge, with labored respirations. These symptoms last a few hours and disappear, but the animals die in a day. Occasionally hemmorhage into the stomach is found postmortem. Dropped into the eye of rabbits, the pupil contracts—resembling *A. muscaria* and muscarin. Boiling the extract does not change its action. This significant record entitles this Inocybe likewise to a place among the more dangerous toadstools.[41,1]

Inocybe sp. agrees in biologic pharmacology very closely with the preceding and the same conclusions are justified in this newest addition to a bad family. Agglutinin powerful, but thermolabile. A muscarin-pilocarpine poison.[50]

THE GENUS HEBELOMA

Hebeloma is closely related to Inocybe. The generic distinctions may be learned in order that the mycophagist may reject both genera as inedible. They

never will be missed, anyway. Little is known about them. *Hebeloma sinapizans* is suspected (eaten with a gay mixture which included l'Amanita jaune citrone).[51] *Hebeloma fastibile* is related to Inocybe.[17] Robert would class *I*. *rimosa* and *H. fastibile* in the rnuscarin group.[1] Ford[50] reports favorably on *H. crustuliniforme* and another closely related species, even though the former is called "poison pie" in England.

Summary of Brown-Spored Genera

In summarizing the brown-spored group we have to take strong exception to the recent Idea that none are known to be poisonous. Pholiota has some edibles worth while but the importance that *P. autumnalis* (perhaps identical with *P. marginata*) has recently achieved as a dangerous species is an unexpected warning on the family. Flammula has fair edibles and is free from suspicion at present. Kauffman's long and careful studies on the glorious genus Cortinarius will now enable us to begin to record the qualities of its species with some hope of accuracy. Past experience on its species warrants the statement that they are pretty safe esculents. The remaining brown-spored families should be rejected.

PURPLE-BROWN-SPORED AGARICS

Hypholoma sublateritium is regarded as poisonous in Europe. It is sometimes bitter, and on this account alone, like many other fungi, has probably been wrongly labeled. Our Club members have occasionally found the "Bricktops" and others inedible, on account of taste. Kobert stages that the "Falscher Stockschwamm," *H. fasciculare*, is not edible. Kunkel says it may be poisonous but not very. *H. instratum* and *Psilocybe* cernua both produce acute intoxication in guinea pigs, fatal in three days. Internal and subserous hemorrhages and enlarged glands were found postmortem. (*Morchella esculenta*, the Morel, produces similar findings). Edible properties are not recorded. No fatalities in man have been referred to Hypholoma and there are many edible species.

Agaricus or Psalliota—the meadow mushroom family—contains the most famous and most sought edibles, a number of species. Any one who knows of the woods-inhabiting species in the genus would probably know and avoid the deadly Amanitas growing among them. Though they do occur, it is very rare for the dangerous white Amanitas to get out into the open grassy haunts of *Agaricus campestris* and *Lepiota naucina*. But no one should rely on usual habitat as his safeguard. He should know well the appearances in detail of the plant he may safely use. We know that two of our Michigan fatalities were due to children wandering into the woods and adding *Amanita phalloides* to "the meadows" they had collected, and three other Michigan deaths were caused by mistaking the "Destroying Angel" for *Lepiota naucina*.

BLACK-SPORED AGARICS

Ford, in 1907, stated that no cases of poisoning have ever resulted from the use of any of the purple-spored or black-spored Agarics. I am of the opinion that a good many cases of the milder type have been caused by both Coprinus and Panaeolus. It will come as a shock to the lovers of the old reliable "inkies" to find them candidates for the increasing cohort of poisonous fungi. Their reputation has been as fair as their spores are black. That of the "shaggy mane" has been traced back to Pliny.

In "Good Housekeeping" (October, 1910) Dr. Cleghorn tells of ten people in four families accustomed to using ink caps, being made ill on three different dates by *Coprinus comatus*. The appearance was as of one intoxicated. There was failure of muscular coordination, standing being difficult and walking impossible. Drowsiness, loss of emotional control, bloodshot eyes, enlarged pupils, incoherent or inappropriate speech were the symptoms coming on in a few minutes or hours after eating. There was no prostration and heart and lung action were strong and regular. One patient complained of the apparent bending and swaying of the furniture. One had a temporary complete paralysis of the left arm. Practically no food had been eaten but the ink-caps. Prof. John Dearness[58] suggests *Panaeolus campanulatus* as the cause in these cases but in view of the circumstances reported this hardly seems likely. Detroit cases of unpleasant effects—more than an acute indigestion—have been reported from taking beer with a meal of *C. comatus*. I have also known of four cases in which flushed face, bloodshot eyes and rapid and distressing heart action followed the eating of *C. atramentarius*. In two of these cases no alcoholic beverage had been taken. In the other two, only a very small amount to which the individual was accustomed. Further reports concerning the inkies are desirable.

Ford[22] has examined *Panaeolus retirugis* only. It is regarded as edible by all authorities but is similar to *P. papilionaceus* which though edible, has been known to produce a peculiar intoxication. He found no hemolysin or agglutinin. Fatal to guinea pigs and postmortem negative. *P. campanulatus*, classed as poisonous by Murrill, is eaten by McIlvaine. Its bad reputation goes back to 1816 and has not been taken seriously. A Minneapolis report says that two rather delicate ladies ate of it—two tablespoonsful of stew. Drowsiness came on quickly; a sensation of intoxication, dizziness, staggering, trembling, numbness, contraction of the jaw, stricture of the throat, precordial distress, headache with sensation of fullness, face flushed and eyes injected, no nausea. Delusions of sight accompanied insomnia—the patients saw big red automobiles in the room or queer figures on the wall paper. The eyelids in one case were temporarily paralyzed. Mild but irritant diarrhea. In one case the heart was intermittent for a week. Recovery was not prompt. A third and more vigorous patient only tasted the stew. Two hours later she complained of dizziness, ringing in the ears and dry throat.

P. papilionaceus, "The Butterfly," has flitted into and out of the questionable list. McIlvaine has seen it produce hilarity and other mild symptoms of intoxication, soon over. Moderate quantities have no effect. Murrill does not rank it as certainly bad. It is a small uncommon Agaric and may therefore be easily spared. In nine years experience in cultivating the gardener's mushroom I have not seen the Coprini or Panaeoli coming on the beds in amount sufficient to warrant the picking of them, but know that *P. subbalteatus* has thus occurred.

BOLETUS AND GYROMITRA ESCULENTA

BOLETUS

Though these volumes deal only with the Agarics, or gilled fungi, a paper on mushroom poisoning would not be satisfactory did it fail to include some matter on the Boleti and on Gyromitra, especially since we have some positive data to report.

Ford[22] says that the definitely poisonous Boleti are not many, and that even the toxic, by reason of their bad taste or emetic or purgative action, protect the user from great harm. But few deaths have been traced to Polypores. Among the important esculents are *B. edulis*, *B. scaber* and *B. granulatus*. The majority are edible, but bitter and wormy varieties are common, and others produce vomiting and diarrhea. McIlvaine regards the genus as very safe. On the other hand, a gentleman at Walloon Lake, Michigan, after spending some weeks testing Boleti, said he had not found one variety that did not make him sick! Warren (Port Huron) says, "I never eat them and I tell others to let them alone. There are too many good kinds to bother with wormy Boletus." *B. satanus* and *B. luridus* are everywhere called poisonous, though the toxic principle is little known. Robert found muscarin in the latter, but conservative Michael says it is edible. *B. clintonianus*, *B. cavipes*, *B. paluster*, *B. chrysenteron* var. *sphagnotum* were all found[22] free from muscarin or definite poisonous action on guinea pigs and rabbits. Variety *sphagnorum* has not been reported edible but *B. chrysenteron* and the other three are approved. McIlvaine, after years of testing by many people, is very positive that both *B. satanus* and *B. luridus* are edible. *Boletus felleus* is free from hemolysins and agglutinins and muscarin, but produces chronic intoxication in rabbits and guinea pigs, fatal in two or three weeks. Extract from the dried plant produced a steady emaciation in rabbits and progressive cachexia in guinea pigs. Probably to be classed as poisonous.[40] Very bitter and inedible.

B. chromapes: No hemolysin, agglutinin nor muscarin. Poisonous only to guinea pigs. Decision deferred. Edible (McIlvaine).

B. affinis and *ornatipes*: A thermolabile agglutinin destroyed at 150° F. No definite action. Edible (McIlvaine).

B. bicolor: An agglutinin; negative on hemolysin and muscarin. Non-toxic. One of the very best esculents (McIlvaine).

B. separans: An agglutinin requiring boiling for its destruction, non-toxic. Edible, McIlvaine and Hard.

B. ravanelli seems to be safe but not tested by actual use.

B. roxanae, similar to *B. separans*. Dietic properties unknown.

B. miniato-olivaceus should be regarded with suspicion because of the report on its var. *sensibilis* (below). Ford[40] finds it to contain a heat-resistant agglutinin and to be poisonous to guinea pigs by chronic emaciation. Rabbits were not affected. No evidence of muscarin. (Compare *Clitocybe dealbata* versus *C. sudorifica*.)

B. pachypus has a bitter taste and a bed-bug odor.[11] A case of poisoning which Hockauf would refer to cheese, has been credited to it. Murrill adds *B. ferruginatus*, *B. eastwoodiae*, *B. frostii* (edible, Peck), *B. morrissi*, and *B. rubinellus* to the uncertain or suspected. Fabre, in a chapter on insects and mushrooms, (Life of the Fly), records that his peasants eat *B. satanus* and other doubtful species after boiling them in salt water and rinsing.

Boletus miniato-olivaceus var. *sensibilis*. It will be seen from the above that our opinions on some species of *Boletus* are much at variance. The following case illustrates how effectively a student of mycology can add to our knowledge by following up thoroughly, and reporting cases of poisoning. Collins[59] records that a certain Boletus—found to agree with the erroneously-figured edible *B. subtomentosus* in Palmer's "Mushrooms of America"— was broiled and eaten for breakfast. Three persons ate sparingly and two ate freely. In two hours vomiting and then purging, with collapse calling for brandy and ether subcutaneously in one case, with narrowing or closing of the field of vision, coldness and helplessness, came on. There was no vertigo, headache nor acute pain. The action was mostly that of an irritant. Coffee was the principal stimulant used. One patient did not recover fully for several weeks. Fresh Boletus specimens were soon secured from the original spot and again one year later. These were identified by Peck as *B. miniato-olivaceus* var. *sensibilis*.

GYROMITRA ESCULENTA

This fungus is also known as *Helvella esculenta*, the false Morel, and the Lorchel. Our Michigan species may include *G. brunnea*. Dispute still rages around this fungus and this is characteristic of a species that contains a minor poison or an inconstant one or one that affects only a few individuals and these only at certain times. *G. esculenta* has a long criminal record in Europe. Nevertheless, it is not everywhere under the ban even there, for its sale, dried or fresh, is permitted in Berlin and Munich though forbidden in Austria. Dried,

dusty, wormy (Anobium and Tinea), specimens are sold in the shops; old and inferior fresh ones at reduced prices in the markets. Several American authors say that only old specimens are dangerous. This is not true. The poison is very soluble in hot water and hence parboiling and rinsing may render the mushroom safe. Kobert says that all the Morchellas are safe but that the False Morel furnishes a record of over one hundred and sixty cases of poisoning. Hockauf[60] reports four cases with one fatality (girl of nine years) in April, 1905. Loevegren also has five cases with a fatality, in a girl of five years. Vomiting, colic, weakness, irregular respiration, tonic cramps of voluntary muscles, dilated pupils, jaundice and prolonged unconsciousness were the chief symptoms. Death may occur on the first day or in five days. The active principle has long been known as helvellic acid and has a true blood-dissolving action shown by the hemaglobinuria, icterus, and the pigmentation of the spleen. Nephritis and fatty degeneration of the liver are also found at autopsy. *Gyromitra esculenta* stands alone in producing a true hemolytic set of postmortem appearances. Frey says that this form of poisoning seems to have become very rare. *Amanita phalloides* does not produce it. Animal tests following Hockauf's cases were negative. Kobert says the fresh extract is very variable. Allen (California) reports *G. esculenta* plentiful there and one of the best edibles, but that it should be let alone. In Michigan it begins to appear on the edge of melting snow banks even as early as mid-March and I have seen a small fall crop in northern Ontario in September. It is common about Port Huron and is eagerly sought and even sold in the markets. Warren and Peck (letters) and Dearness[58] report a number of illnesses and at least one fatality due to Gyromitra. In the cases of Dearness the family were made ill after eating of the warmed-over cooking. Coma and death of one adult came on the fourth day. In the Michigan cases there were two groups of nine people each who ate, with two illnesses in each group. Symptoms came on in about six hours. Very violent vomiting and diarrhea, with much weakness and fear were the chief symptoms. Heart action was good. The acute illness lasted thirty-six hours, inability to take food three days, and recovery required about five days. "No other ill effects except that they don't want any more Gyromitras." The fungi were fresh and prepared as often before—and since. Warren says, "I know they may contain some kind of poison that affects some people at certain times."

Ford[41] has examined specimens of *G. esculenta* from Massachusetts. He found them entirely negative and harmless in every method of testing on guinea pigs, rabbits and the frog's heart.

CONCLUSIONS AND SUMMARY

Because of the growth of popular interest in the study of the mushrooms and toadstools, both as a "fad" and as a scientific past-time, and because of the influx of foreigners accustomed to use fungi for food, the subject of mushroom poisoning is assuming increasing importance in America.

The white Amanita or Death-cup (*Amanita phalloides*) and its few closely related species are responsible for at least nine-tenths of all fatal cases of mushroom poisoning. In illness caused by this fungus the mortality runs very high. Symptoms are six to ten hours in coming on. Suffering is extreme, and death often does not occur until a week or more has elapsed, though the course is quicker in children. There is no antidotal treatment. Clinical course and post-mortem findings are characteristic.

The white Amanita group contains a toxin found in no other fungi. It is a poison which causes profound degenerative changes in the internal organs and in the cells of the central nervous system.

The white Amanitas are easily recognized and avoided.

In all cases of mushroom intoxication, it is the duty of physicians and of friends to make every effort to learn whether or not *Amanita phalloides* has been eaten or whether some less dangerous toadstool is causing the sickness. Such determination is important both in determining treatment and especially prognosis.

The yellow Amanita or "Fly Fungus," *Amanita muscaria*, is second in importance. It is much less poisonous. It produces characteristic symptoms unlike those of *A. phalloides*, coming on in three hours or less, showing prompt disturbance of the nerve centers, and a disease of shorter course and lower mortality. The degenerative changes seen in *A. phalloides* intoxications, do not occur. If fatal results occur, this outcome may be expected early.

A large part of the disturbances produced by *Amanita muscaria* are due to the muscarin constituent of the fungus. This poison can be counteracted by the drug atropin. Hence *A. muscaria* intoxication is somewhat amenable to treatment.

Physicians should be able to distinguish between these two forms of poisoning. Symptoms are not always definite enough to be relied upon, and specimens of the mushroom which has been eaten should be identified. Local or near-by botanical centers are always glad to be of service in such problems.

A number of minor poisonous species of mushrooms (about twenty) produce symptoms, when eaten, *which resemble the action of muscarin*. These species have not been given the importance and attention which they deserve. They usually also have an emetic action which prevents fatal consequences. Some of them are violent gastro-intestinal irritants and may thus add gravity to the illness. Deaths from them are almost unknown in healthy adults. Determination of the species is of great practical and scientific importance, since these minor cases are more numerous than is generally supposed.

Physicians and students of mycology should report cases in medical or botanical journals. Cases reported in the newspapers should be investigated.

Species closely related botanically may differ very widely in poisonous quality, though this is not usual. No variety should be eaten until its specific name has been determined by competent authority. If its edible qualities are not known or are in dispute, testing should proceed cautiously. The eating of mixed lots is to be condemned unless the user positively knows the reputation of each species to be good. Parboiling is a partial safeguard. None but clean, fresh specimens should be used, and these should be thoroughly cooked and indulged in only in moderation. Most mushrooms are not easily digested. Warmed-over portions are occasionally found to have developed toxic principles.

Good and abundant edible varieties are common, and the lover of fungi need take no chances. He can easily acquire a personal edible list, and can add new species to it as his knowledge and experience grow. Scientific mycology should precede mycophagy and increase one's pleasure in eating fungi.

BIBLIOGRAPHY

(A) BOOKS CONSULTED

ATKINSON, GEO. F., Mushrooms, Edible, Poisonous, etc., 1900. Third ed. 1911. Very useful to the beginner; beautifully illustrated with photographs.

BARLA, J. B., Les Champignons de la prov. de Nice, 1859. With 48 colored plates of the common edible and poisonous species, with full descriptions. Flore Mycologique illustree Les Champignons des Alper-Maritimes, 1889-92. With 64 large, colored plates of species of Amanita, Lepiota, Armillaria, Clitocybe and Tricholoma.

BERKELEY, REV. M. J., Outlines of British Fungology. 1860. A manual, with 24 colored plates of many species.

BOUDIER, E., Icones Mycologicae ou Iconograph, d. Champignons de France, 1904. A series of the most accurate and most beautiful colored plates of fungi yet published; a relatively small number belonging to the Agarics. It is very expensive.

BRESADOLA, ABBE J., Fungi Tridentina, 2 vol., 1881-1900. Illustrated with 217 colored plates; a critical study of the rarer or confused species; invaluable to the specialist. I. Funghi mangerecci e. velenosi, 1906. Illustrated with 120 colored plates and descriptions in Italian of the more common edible and poisonous species.

CLEMENTS, F. C., Genera of Fungi. This is a useful book of keys to the genera, largely taken from Saccardo and adapted to those who cannot read Latin. It contains no descriptions.

COOKE, M. C., Handbook of British Fungi., 2 vol., 1871. With full descriptions of species. Not as helpful as either Massee or Stevenson. Illustrations of British Fungi. Eight volumes of colored plates illustrating practically all the Agarics of Great Britain; 1,198 plates in all. Necessary to the specialist.

COOKE ET QUELET. Clavis Synoptica Hymenomycetum Europaeorum. A useful little book with brief Latin descriptions of the Hymenomycetes of Europe, arranged in the form of a pocket manual.

CONSTANTIN ET DUFOUR. Nouvelle Flore des Champignons. A useful French book for beginners arranged in the form of keys, illustrated by 4,265, diagramatic line drawings. Mostly Hymenomycetes which are known in France.

"ENGLER AND PRANTL", Die Naturliche Pflanzen-familien. The volume containing the Basidiomycetes; one of many volumes covering an outline of the whole plant kingdom to the genera; profusely illustrated with woodcuts. Indispensable to the mycologist.

FARLOW, W. G., Bibliographical Index of North American Fungi, 1905. Giving the references to the literature for each species; only Vol. I, part I, has appeared to date.

FRIES, ELIAS MAGNUS. Systema Mycologicum, 3 vol. Vol. I. contains the Basidiomycetes, 1821. This volume and its date was made the starting point for the nomenclature of the Agarics by the International Congress meeting at Brussels, 1910. Epicrisis Systematis Mycologici, 1836-38. An extension of Vol. I of Syst. Myc. with changes and additional species. Monographia, 1857-63. Being a series of monographs of the genera of the Agaricaceae; nearly all the species mentioned in this work are illustrated by colored drawings which are now deposited in the Royal Museum-at Stockholm. It includes only Swedish species, but the descriptions are followed by commentaries and are invaluable to the specialist. Hymenomycetes Europaei, 1874. This is one of the most important and fundamental works on the Basidomycetes ever published. It represents the ripe experience and best judgment of the master. Sveriges ätliga och giftiga Svam par., 1862-69. A volume of large plates with colored figures of the edible and poisonous species of Scandinavia. Icones, 1867-1884. Two volumes of 200 large colored plates of the Basidiomycetes, selected from the large number of drawings deposited at the Museum at Stockholm.

GIBSON, W. H., Our Edible Toadstools and Mushrooms, 1895. (Ed. new, 1903.) A book written in a delightful literary vein, containing popular descriptions and discussions of some forty mushrooms; well illustrated with colored drawings.

GILLET, C. C. Les Hymenomycetes, 1874. A manual with full descriptions and artificial keys to all the Basidiomycetes growing in France. Very valuable. Les Champignons de France. A set of 712 colored plates accompanying the preceding manual.

HARD, M. E., Mushrooms Edible and Otherwise, 1908. A popular book for the beginner, profusely illustrated with photographs.

HERBST, WM., Fungal Flora, of the Lehigh Valley, Pa., 1899. This book contains descriptions and 25 plates.

HUSSEY, Illustrations of British Mycology, 1847-55.

KARSTEN, P. A., Mycologia Fennica, 4 vol. Vol. 3—Basidiomycetes. A manual of the flora of Finland.

LINDBLAD, M. A., Svambok, 1902, a popular manual in Swedish.

MARSHALL, NINA L., The Mushroom Book, 1905. "A popular guide to the identification and study of our commoner fungi, with special emphasis on the edible varieties." With photographs, many colored.

MASSEE, GEO., British Fungous Flora, 4 vol. 1892-95. A useful manual for the English reader, but deals only with British forms. European Fungus Flora; Agaricaceae, 1902. A compilation of all European species of Agarics with only the essential characters given in brief description. Text book of Fungi, 1906. A general discussion of matters of interest and importance to the student of fungi, mostly of others than Agarics.

McILVAINE, CHARLES, One Thousand American Fungi, 1900. New ed., 1912. A valuable compilation of descriptions of fungi formerly inaccessible to many. The last edition is well illustrated. An additional value of this book is in the data concerning the edibility of mushrooms as tested by the author.

MICHAEL, EDMUND, Fuhrer für Pilzefreunde. 3 Vol., 1903-05. Containing in all 307 beautifully colored plates of mushrooms, unusually true to nature cheap and very helpful to the beginner.

MURRILL, W. A., Agaricaceae. North Amer. Flora, Vol. 9 et al., 1910.

OUDEMANS, C. A. J. A., Revision des Champignons dans les Pays-Bas, 1893. Vol. I contains synopses and descriptions of Hymenomycetes of Holland; in French.

PATOUILLARD, N., Tabulae Analyticae Fungorum, 1883-89. A critical study of many species, with numerous colored figures; invaluable to the specialist. In French. Les Hymenomycetes d'Europe, 1887. Deals with the general anatomy and classification of the higher fungi.

PERSOON, C. H., Synopsis Methodica Fungorum, 1801. One of the best early efforts to place the classification of fungi on a scientific basis; in some groups it is considered by some as more fundamental than the works of Fries.

QUELET, L., Enchiridion Fungorum, 1886. A manual, in Latin, of the species found in Middle Europe and France. Les Champignons de Jura et des Vosges, 1872. Classification and descriptions of some 700 species found in the mountainous regions of eastern France.

HICKEN, A., Die Blätterpilze (Agaricaceae). A manual, in German, of the Flora of Germany, with excellent modern descriptions, and profusely illustrated by colored plates. Appearing in parts; 1910-16. One of the most useful and complete works of its kind, giving the microscopic characters of most species. Invaluable to the student.

SACCARDO, P. A., Sylloge Fungorum. A work of huge scope including descriptions, in Latin, of all known species of the world, 1882—. It comprises to the present 22 volumes; Vol. V, and parts of later volumes, deal with Agarics.

SCHROETER, J., Die Pilze Schlesiens, 1889. A manual with full descriptions of the Agarics indigenous to Silesia.

SCHWEINITZ, L. de, Synopsis Fungorum.

SECRETAN, L., Monographic Suisse, 1833, 3 vol. Descriptions and classification of fungi growing in Switzerland.

SMITH, W. G., Synopsis of the British Basidiomycetes. Brief diagnoses and sketches of all Agarics of Great Britain; spore-size not given.

STEVENSON, REV. JOHN, British Fungi, 2 vol., 1886. A manual of the British Hymenomycetes, whose descriptions are largely those of Fries. Very useful to the student who reads only English. The same descriptions of many species are also found in Mcllvaine.

SWANTON, E, W., Fungi and How to Know Them, 1909. A book for the beginner dealing in a popular way with all fungi, as well as Agarics; profusely illustrated with colored figures and cuts in black and white. The beginner will find it useful.

TAYLOR, THOMAS, Student Hand-book of Mushrooms of America, 1897. A series of fine pamphlets bound in book-form, with 14 colored plates dealing with a few common edible and poisonous mushrooms.

UNDERWOOD, L. M., Moulds, Mildews and Mushrooms, 1899. A small, compact text-book on the classification of fungi, with keys to families and genera, good bibliographies and explanatory notes on families; invaluable to the student who reads only English.

VITTADINI, Descriz. dei Funghi Mangerecci e velnosi d'ltalia. Milan, 1835. A carefully written work of the mushrooms of Italy.

WINTER, GEO., Die Pilze Deutschlands, Oesterreichs und der Schweiz. A manual of the flora of the Basidiomycetes of Germany, Austria and Switzerland, with full descriptions; it is Vol. I, Part I, of Rabenhorst's Kryptogamen Flora.

(b) JOURNALS OF MYCOLOGY CONSULTED

(For special papers in other journals, see (C) and text)

ANNALES MYCOLOGICI. Entirely devoted to fungi; articles are printed in various languages.

BULLETIN DE LA SOCIETE MYCOLOGIQUE DE FRANCE. Entirely devoted to fungi; in French. Started in 1885.

BULLETIN OF THE TORREY BOTANICAL CLUB. Containing some papers on fungi, especially the descriptions of new species by Dr. Peck of such as were sent to him from outside of New York State; an American Journal.

GREVILLEA. Published in England from 1892 to 1894. Devoted to Cryptogamic Botany and its literature; contains descriptions of the species in Cooke's Illustrations. Includes many references to American species.

HEDWIGIA. A German journal dealing with Cryptogamic Botany; 1852 to the present.

JOURNAL OF MYCOLOGY. An American journal devoted to fungi, super-ceded by Mycologia. 1885-1908.

MYCOLOGIA. Started in 1909; devoted to mycology; published by the New York Botanical Garden.

MYCOLOGICAL BULLETIN. A popular journal for the beginner which had a brief existence during four and one-half volumes.

MYCOLOGICAL NOTES. Published privately by C. G. Lloyd since 1898. Devoted to critical notes and synopses of the higher fungi.

REVUE MYCOLOGIQUE. A French journal for mycologists, started in 1879.

RHODORA. Published by the New England Botanical Club. Contains articles on fungi of New England.

TORREYA. Published by the Torrey Botanical Club, New York City. Containing occasional papers on Agarics, beginning 1901.

(C) STATE REPORTS, FLORAS, KEYS, LISTS, ETC.

ATKINSON, G. F., and STONEMAN, BERTHA, Key to the Genera of Hymenomycetes. Ithaca, N. Y.

BRADY, W. A., A Partial List of the Fungi of Wisconsin: Geol. of Wis., Vol. I, p. 396, 1883. (Includes 218 species of Basidiomycetes.)

BURLINGHAM, GERTRUDE S., Some Lactarii from Wyndham Co., Vt: Bull. Torr. Bot. Club, Vol. 34, 1907. (Contains a synopsis, list and new species.)

BURT, E. A., Key to the Genera of the Basidiomycetes of Vermont: Contrib. to the Bot. of Vt., VI, 1899.

CLEMENTS, F. C., Minnesota Mushrooms: Geol. and Nat. Hist, Surv. of Minn. Minn. Plant Studies, IV, 1910. (Published in book form for use in schools with descriptions and keys; profusely illustrated with photographs.)

CURTIS, M. A., Catalogue of the plants of North Carolina, Raleigh, 1867.

EARLE, F. S., (collaborator), Plant Life of Albama: U. S. Dept. of Agr., Nat. Herbarium, Vol. 6, p. 150, 1901, (including a full list of the fungi reported from Alabama). The Genera of North American Gill Fungi: Bull. New York Botanical Garden, Vol. 5, p. 373, 1908. (Keys and descriptions of genera, classified according to the rule of priority.) Keys to species of various genera: Torreya, Vol. 2, (Russula, Hygrophorus, etc.).

FARLOW, W. G., List of Fungi found in the vicinity of Boston: Bul. Bussey Institution, I, p. 430, 1876; II, p. 224, 1878.

FROST, C. C., Further enumeration of New England Fungi: Proceed. Soc. Nat. Hist. Boston, Vol. XII, p. 77, 1869.

GLATFELTER, N. M., Preliminary list of higher Fungi, etc.: Acad. Sci. of St. Louis, Vol. XVI, No. 4, p. 33, 1906.

HESS AND VANDAVERT, Basidiomycetes of Central Iowa: Proceed. Iowa Acad. Sci., Vol. 7, p. 183.

KAUFFMAN, C. H., Michigan Fungi: Seventh Ann. Rep. Mich. Acad. Sci., p. 64, 1905. Unreported Michigan Fungi: Eighth Ann. Rep. Mich. Acad. Sci., p. 26, 1906. Ibid: Ninth Ann. Rep., p. 83, 1907. Ibid: Tenth Ann. Rep., p. 63, 1908. Ibid: Eleventh Ann. Rep., p. 55, 1909. Ibid: Twelfth Ann. Rep., p. 99, 1910. Ibid: Thirteenth Ann. Rep., p. 215, 1911.

LONGYEAR, B. O., A preliminary list of the Saprophytic Fleshy Fungi known to occur in Michigan: Fourth Rep. Mich. Acad. Sci., p. 113, 1904. List of saprophytic Fungi: Rep. of Sec. to State Board Agr., 1898.

MACBRIDE, T. H., The saprophytic fungi of Eastern Iowa: Bull. Tab. Nat. Hist. State Univ. of Iowa, Vol. I, p. 30, 1888. Ibid: p. 181, 1890. Ibid: p. 196, 1890.

MOFFATT, W. S., The higher fungi of the Chicago Region: Nat. Hist. Surv. of Chicago Acad. Sci., Bull. VII, part 1, p. 1, 1909. Descriptions and 24 photo plates; including 360 species of Basidiomycetes.

McKAY, A. H., Fungi of Nova Scotia; a preliminary list: Proceed, and Trans. Nova Scot. Inst. Sci., Vol. XI, part 1, p. 125, 1904. Includes 284 species of Basidiomycetes.

MILLSPAUGH and NUTTALL, Flora of West Virginia: Field Columb. Mus., Bot. Ser. I, p. 60, 1896.

MORGAN, A. P., The Mycologic Flora of the Miami Valley, Ohio: Journ. Cinn. Soc. Nat. Hist., Vol. 6, p. 54-81, 97-115, 173-199. With descriptions and six plates.

PECK, CHAS. H., New York State Mus. Reports, published in the Annual Reports of the New York State Museum of Nat. Hist., and also separately as Reports 27-54 consecutively, afterwards as Bulletins until 1912 when Dr. Peck retired. The reports of Peck as State Botanist from 1870-1912, include plants of all groups, but the greater portion is devoted to lists of fungi found in New York State, to descriptions of new species, and to synopses of many of the genera of Agarics. See also bibliography of each genus. Fungi of Maryland: New York State Mus. Rep. 44, 1891. A list prepared by Mary E. Banning of Baltimore and including about 100 Agarics.

REDDICK, D., A preliminary list of the Hymenomycetes of Indiana: Dept. of Geol. and Nat. Resources of Ind., Rep. 32, p. 1193, 1907. A list including 88 Agarics.

SPRAGUE, C. J., Contributions to New England Mycology: Proceed. Bost. Soc. Nat. Hist, Vol. 5, p. 325, 1856; Vol. 6, p. 315, 1859.

STOVER, W. G., The Agaricaceae of Ohio: Proceed. Ohio State Acad. Sci., Vol. V, part IX, p. 462, 1912. Keys to the genera and species; comprising 540 species without descriptions.

UNDERWOOD, L. M., Report of the Botanical Division of the Indiana State Biological Survey: Proceed. Ind. Acad. Sci., p. 13, 1894; p. 144, 1895; p. 171, 1896.

VAN HOOK, J. M., Indiana Fungi: Proceed. Ind. Acad. Sci., p. 205, 1910; p. 347, 1911. Includes list of 347 Basidiomycetes.

WEBBER, H. J., Catalogue of the Flora of Nebraska: Rep. Neb. State Board Agric., p. 37, 1890.

WHITE, E. A., Hymeniales of Connecticut: Conn. State Geol. and Nat. Hist. Surv. Bull. 3, 1905; 15, 1910. Contain lists, keys to species and a few descriptions; illustrated with photographs of 28 and 39 plates respectively. Reference to 433 species of Basidiomycetes.

(D) MISCELLANEOUS BOOKS, PAMPHLETS, PAPERS, ETC.

ARTHUR, J. C., Three edible toadstools: Purdue Univ. Agr. Exp. Sta., Bull. No. 98, 1904.

ATKINSON, G. F., and SHORE, R. B. Mushroom growing for amateurs: Cornell Univ. Agr. Exp. Sta., Bull. 227, 1905. Mushrooms: Ibid, Bull. 168, 1899.

BADHAM, C. D., A Treatise on esculent funguses, 1847. (A British book, with 21 colored plates.)

BATES, Mushrooms—poisonous Amanitas, harmless Agarics (directions for cultivation): Amer. Florist, Vol. II, 1896.

BEACH, S. A., Mushrooms as a Greenhouse Crop: N. Y. State Agr. Exp. Sta., Bull. 88, 1895.

BIFFEN, R. H., On the biology of *Collybia velutipes*: Jour. Linn. Soc., Vol. 34, p. 147.

BRITZELMAYR, M., Materialen zur Beschreibung der Hymenomyceten: Bot. Centralblatt, Vol. 53-54, p. 33, 65 and 97, 1893; Vol. 62-63, p. 273, 1895; Vol. 71-72, p. 49, 1897. (Brief critical notes on European Agarics, with spore size.) Revision der Diagnosen zu den von Britzelmayr, aufgestellten Hymen. Arten., Bot. Centralblatt, Vol. 75-76, p. 129, 169, 203, 1898; Vol. 77-78, p. 356, 395, 433, 1899; Vol. 79-80, p. 57, 116, 1899. (Full description of the species described as new.)

BULLER, A. H. K., Researches on Fungi, etc., 1909, (a valuable study of spore expulsion in Coprinus, etc.).

BULLETIN, Boston Mycolog. Club, 1897, * * * (small pamphlets giving directions to amateurs, with brief descriptions of the species of some genera).

BURECK, A., Notes on enemies of mushrooms and on experiments with Remedies: U. S. Dept. of Agr., Entomol., 32-35.

BURT, E. A., Collecting and preparing fleshy fungi for the herbarium: Bot Gaz., Vol. 25, p. 172, 1898.

COOKE, M. C., British edible fungi and how to distinguish and how to cook them. Edible and poisonous mushrooms; what to eat and what to avoid. (With 48 colored plates.)

CORDIER, F. S., Les Champignons, Paris, 1876, 4th ed. with 60 colored plates.

DAVIS, SIMON, Fleshy fungi of Stow, Mass.: Rhodora, Vol. 13, p. 57, 1911; Vol. 16, p. 45, 1914 (critical notes).

DUGGAR, B. M., The principles of mushroom growing and mushroom spawn-making: U. S. Dept. Agr., Bureau of Plant Ind., Bull. 85, 1905. (The best modern discussion of the subject.) The cultivation of mushrooms: Farmer's Bull., No. 204, U. S. Dept. Agr., 1904.

FALCONER, WM., How to grow mushrooms: Farmer's Bull., U. S. Dept. Agr., No. 53, 1897.

FAYOD, V. M., Prodrome d'une Historie Naturelle des Agricenes: Ann. des Nat. Botanique, 7 series, Vol. 9, p. 181.

FARLOW, W. G., Some edible and poisonous fungi: U. S. Dept. Agr., Bull. No. 15, 1898. Notes for mushroom eaters: Reprinted from Garden and Forest Magazine.

GAUTIER, L. M., Champignons, Paris, 1884.

GOWDY, J. K., Mushroom culture in France: U. S. Consular Rep. 66, p. 259, 537, 1902.

HARKNESS and MOORE, Catalogue of the Pacific Coast Fungi: Calf. Acad. Sci., 1881.

HASTINGS, SOMERVILLE, Toadstools at home: Gowan's Nature Series, No. 7, London, 1908. (60 photographic reproductions of fungi in their natural surroundings; excellent little primer.)

HAY, WM. D., Fungi hunter's guide, London, 1887.

HENDERSON, L. P., Mushrooms or toadstools, a natural food-product: Idaho Agr. Exp. Sta., Bull. 27, p. 27.

HESS, ALICE W., A few common fleshy fungi of Ames, Iowa: Iowa Agr. Exp. Sta., Bull. 61, p. 148.

HOGG, ROBERT and JOHNSON, G. W., A selection of the edible funguses of Great Britain, London.

HYAMS, C., Edible fungi of North Carolina: N. Car, Exp. Sta., Bull. 177, p. 27.

JONES, C. H., Composition of mushrooms: Vermont Agr. Exp. Sta. Bull., p. 196, 1903.

KAUFFMAN, C. H., Mushrooms: Nature Study Review, Vol. 8, p. 1.

LANGWORTHY, C. F., Mushrooms as Food: Plant World, Vol. 8, p. 134, 1899.

LONGNECKER, A. M., Mushrooms: Plant World, Vol. 5, p. 213.

LONGYEAR, B. O., Remarks concerning saprophytic fungi, etc.: Mich. Acad. Sci., Rep. 1, p. 97, 1897. Notes on Michigan Saprophytic Fungi: Mich. Acad. Sci., Rep. 3, 1901.

MARCEAU, L., Flore des champignons superior du Department de Saone-et-Loire, 1898. (A manual with extensive keys.)

MANGET, C., Tableux synoptiques des champignons comestible et venenaux, Paris, 1903.

MAY, W. J., Mushroom culture for amateurs, 1897.

MENDEL, L. B., Chemical composition and nutritive value of some edible American Fungi: Amer. Jour. Phys. 1, p. 225.

MOYEN, J., Les Champignons, Paris, 1889.

PALMER, JULIUS A., Mushrooms of America, Boston, 1885. About Mushrooms, Boston, 1894.

PECK, C. H., Descriptions of new species of fungi: Bull. Soc. Nat. Sci. of Buffalo, 1. p. 41, 1873. New species of fungi, (see Bot. Gaz). New species of fungi, (see Torr. Bot. Club Bull., Vol. 22-38). Mushrooms and their uses: Pub. by Cambridge Bot. Supply Co., 1897. The smooth Agaric: Country Gentleman, 1886, p. 833. Edible and poisonous fungi: N. Y. State Mus. Rep. 48, p. 203, 26 Plates, 1895. Report of the State Botanist on the edible fungi of New York State: N. Y. State Mus. Memoir, No. 4, p. 113, 24 Plates, 1900. Lists of all species described and named by Dr. Peck to 1908, see N. Y. State Mus. Bull. 131, p. 59, 1909. List of figures and Illustrations of mushrooms published by Dr. Peck, see N. Y. State Mus Bull. 139, p. 78, 1910.

RIDGWAY, ROBERT, Color standards and color nomenclature, Washington, D. C. 1912. (A series of 1115 named colors, invaluable for the future standardizing of the names of mushroom colors and tints.)

ROBINSON, W., Mushroom culture, London, 1870. (A full account of the older methods.)

SHEAR, C. L., Some common autumnal species of edible Fungi: Asa Gray Bull. 7, p. 93, 1899.

SICARD, G., Histoire naturelle des Champignons, Paris, 1883 (with colored plates).

SMITH, W. G., Clavis Agaricinorum, London, 1870 (Descriptions of families and genera with keys.)

STURGES, W. C., Edible and poisonous fungi: Rep. Sec. Connect. Board of Agr., 1895.

SYDOW, P., Taschenbuch der wichtigeren essbaren u. giftigen Pilze Deutschlands u. der Schweiz. (Pocket size, with colored figures.)

TAYLOR, EMMA L., Guide to the mushrooms. (Small primer, 200 pages and 66 plates.)

TORREY, JR., J., Raising mushrooms in a cellar: Rhodora, Vol. 3, p. 57.

TRELEASE, WM., Edible and poisonous mushrooms: Missouri State Hort. Soc. Rep., 1900, p. 224.

UNDERWOOD, L. N., Edible Fungi—A great vegetable food m Indiana: Trans. Ind. Hort. Soc., 1893, p. 62. Edible Fungi: Alabama Agr. Exp. Sta. Bull. 73, p. 337. Suggestions to collectors of fleshy fungi: Ala. Agr. Exp. Sta. Bull. 80, p. 271.

VIERMEYER, T. J., The Mycogone disease of mushrooms and its control: U. S. Dep. Agr. Bull. No. 127, 1915.

WEBSTER, HOLLIS, See Rhodora, Vols. 1, 2, 4.

WEEMS AND HESS, A study of the food value of some of the edible fungi of Ames, Iowa: Proceed. la. Soc. Prom. Agr. Sci., 1902, p. 105.

WILLIAMS, E. M., Common edible and poisonous Amanitas: Asa Gray Bull. Vol. 6, p. 80.

WINDISCH, E., Mushroom culture on an extensive scale, 1897.

WINDOR, D. K., The Mushrooms of Canada, 1871 (a little primer).

ZEGA, A., Composition of some edible Fungi: Chem. Zeitung, Vol. 26, p. 10, 1902. Mushrooms as food: U. S. Dept. Agr., Farmer's Bull. 79. Analyses of mushrooms: N. Y. State Agr. Exp. Sta. Rep. 1894, p. 134. Preliminary list of the edible fungi of Ohio: Ohio State Univ. Bull. 4, p. 30.

(e) ON MUSHROOM POISONING

BY O. E. FISCHER, M. D.

1. Ford & Clark—A Consideration of the properties of poisonous fungi: Mycologia, July, 1914, Vol. VI, No. 4.
2. Bagnall—Mushroom poisoning, with atypical cases: Boston Med. & Surg. Jour., July 16, 1914.
3. Ford—A clin. study of mushroom intoxication: Johns Hopkins Hosp. Bull., Vol. 18, 1907.
4. Gillot—Etude med. sur. L'empoisonement par les Champignons, Lyon, 1900.
5. Plowright—Brit. Med. Jour., Sept. 9, 1905, Vol. II, p. 541.
6. Pfromm—Med. Bull. Phila., Nov., 1905, p. 401.
7. Murrill—Poisonous mushrooms: Mycologia, Nov., 1910, p. 255.
8. Mycol. Bull., Vol. VI, No. 86, Feb., 1908, quoted from O. E. Jennings in Jour, of Mycol., Sept., 1907.
9. Barr—Letter. Kindness of Minneapolis Mycol. Club.
10. Schuerer—Kasuistischer Beitrag zur Kenntniss der Pilzvergiftungen: Deut. Med. Woch. Schr. XXXVIII, No. 12, Mar. 21, 1912.
11. Hockauf—Zur Kritik der Pilzvergiftungen: Wien Klin Woch. Schr., 1904, p. 731.
12. Maass—Berl. Klin. Woch., June 26, 1905, p. 814.
13. Ford—Jour. Infect. Dis., Vol. 5, 1908, p. 116.
14. Jour. A. M. A.—Vol. LX, 1913, p. 1154.
15. Abel & Ford—Arch. f. Exper. Path. u. Pharm. Schmiedeberg Festschrift, 1908, p. 8.
16. Frey—Zeit Sch. Klin. Med., 1912, p. 455.
17. Same as No. 7.
18. Ford—Jour. Inf. Dis., 1906, Vol. Ill, p. 191.
19. Abel & Ford—Poisons of *Amanita phalloides*: Jour. Biol. Chem., Vol. II, 1907, p. 273.
20. Schlesinger & Ford—Chem. Prop. of *A. phal.*: same as above, Vol. Ill, 1907, p. 279.
21. Ford & Prouty—Note on Amanita-toxin: Jour. Pharm. & Exp. Ther., Vol. I, 1907, p. 389.
22. Ford—Distribution of hemolysins, agglutinins & poisons in fungi: Jour. Pharm. & Exper. Ther., Vol. II, 1910, p. 285.
23. Coville—Observations on recent cases of mushroom poisoning in the District of Columbia: Circ. 13, Div. of Botany, U. S. Dept. Agriculture, 1898.
24. Prentiss—Phil. Med. Jour., 1898, II, p. 607.
25. Ford & Clark—Mycologia, July, 1914, Vol. VI, No. 4.
26. Harmsen—Zur Toxicologie des Fliegenschwammes: Archiv. f. Pathol. u. Pharmacol. Schmiedeberg, 1903.
26a. Ibid —. Bd. 50, p. 361, 1903.
27. Michael—Führer für Pilzefreunde. Zwickau, Sa., 1903.
28. Kennan—Tent Life in Siberia, New Ed., 1910, p. 198.
29. Sumstine—Mycol. Bull., Vol. IV, 56, Apr., 1906.
30. Tappeiner—Munch. Med., Wochenschr, Feb. 12, 1895, p. 133, J. 42, No. 7.
31. Ford & Brush—Note on properties of fungi from France: Jour Pharm & Exp. Ther., Vol. 6, No. 2, Nov., 1914.
32. Same—Action of Amanitas upon the frog's heart. Same as above.
33. Blount—A personal experience with mushroom poisoning, Med. Record, Nov. 23, 1901, p. 815.
34. Chestnut—Asa Gray Bull., Oct., 1900.
35. Webster—Rhodora, Jan., 1915, Vol. 17, p. 30.
36. Farlow—Poisoning by *Ag. illudens*: Rhodora, March, 1899, p. 43.
37. Clark & Smith—Toxicological studies on *Clit. illudens & Inocybe infida*: Mycologia, 1913, p. 224.
38. Mcllvaine & Macadam—One thousand American fungi. Revised Ed
39. Peck—Report of State Botanist, 1911, N. Y., Bull. 157.
40. Ford & Sherrick—Jour. Pharmac & Exp., Ther., 1911, II, p. 549.
41. Same—On *Clit. sudorifica*, etc., etc. Same as above, Vol. IV, 1913, p. 321.
42. Peck—As above, Bull. 150, p. 44.
43. Rabe—Zeitscher. f. exp. Phar. u. Ther., Sept., 1911, p. 352.
44. Bull. Soc. Mycol., de France, 1906, p. 22.
45. Goldman—*Agaricus torminosus*: Wien. Klin. Wochenschr, Mar. 21, 1901.
46. Sartory—Les empois. par les Cham., (Etc., 1912) Paris, 1912.
47. Murrill—A new poisonous mushroom: Mycologia, 1909, p. 211.
48. Clark & Kantor—Toxicological experiments with higher fungi: Mycologia, 1911, p. 175.
50. Ford—Further observations on fungi: Journ. Pharm. & Exp. Ther, Vol VI, No. 2, Nov., 1914.
51. Bull. Soc. Mycol. de France, 1912, p. 28.
52. Same—1909, p. 25 and 1906, p. 22.
53. Jour. A. M. A., LXI, p. 1388.
54. Peck Report, 1895, p. 212. Same, 1901, p. 961.
55. Clark & Smith—Mycologia, 1913, p. 224.
56. Von Wedekind—Med. Record, Dec. 25, 1897, p. 919.
57. Step—Toadstools & mushrooms of the (British) country side.
58. Dearness—The personal factor in mushroom poisoning: Mycologia, Vol. 3, 1911, p. 75.
59. Collins—Rhodora, Vol. I, No. 2, Feb., 1899, p. 21.
60. Hockauf—Wien. Klin. Wochenschr, 1905, p. 1058.

(F) MONOGRAPHS, ETC., ARRANGED BY GENERA

AGARICUS. (See Psalliota).

AMANITA. Peck, N. Y. State Mus. Rep. 33, p. 38, 1880. Lloyd, compilation of the Volvae of U. S., p. 2, 1898. Boudier, Obs. sur.—especes d'Amanitas, Bull, de la Soc. Mycol. de France, Vol. 18, p. 251, 1902. Quelet et Bataille, Flora Monographic des Amanites et das Lepiotas, Paris, 1902. Beardslee, Notes on the Amanitas of the Southern Appalachians, Lloyd's Mycological Notes, Vol. I. See also: Fries, Saccardo, Gillet, Bresadola, Barla, Stevenson, Massee, Atkinson, Mcllvaine, Morgan, Ricken, etc.

AMANITOPSIS. Peck, N. Y. State Mus. Rep. 33, p. 38 (under Amanita). Lloyd, compilation of Volvae of U. S., p. 8, 1898. Quelet et Bataille, Flore monographic des Amanites et des Lepiotas, p. 42, 1902, (under Amanita). See also: Fries, Saccardo, etc. (under Amanita in the older books).

ANNULARIA. (See Chamaeota.)

ARMILLARIA. Peck, N. Y. State Mus. Rep. 43 (Bot. ed.), p. 44, 1899. See also: Mcllvaine, Morgan, Fries, Saccardo, Stevenson, Bresadola, Gillet, Stevenson, Barla, etc.

BOLBITIUS. See Fries, Gillet, Ricken, etc.

CANTHERELLUS. Peck, N. Y. State Mus. Bull. 2 (Bot. ed.), p. 34, 1887. See also: Saccardo, Fries, Gillet, Stevenson, Ricken, Morgan, Moffatt, Mcllvaine, etc.

CLAUDOPUS. Peck, N. Y. State Mus. Rep. 39, p. 67, 1886. See also: Saccardo, Fries, Gillet, Massee, Stevenson, Ricken, Patouillard, etc.

CLITOCYBE. Peck, N. Y. State Mus. Bull. 157, (Bot. ed.), p. 59, 1912. See also: Barla, Mcllvaine, Lloyd, Saccardo, Fries, Bresadola, Gillet, Stevenson, Massee, Morgan, Moffatt, etc.

CLITOPILUS. Peck, N. Y. State Mus. Rep. 42, (Bot, ed.), p. 39, 1880. See also: Saccardo, Fries, Gillet, Stevenson, Massee, Mcllvaine, Morgan, etc.

COLLYBIA. Peck, N. Y. State Mus. Rep. 49, p. 32 (Bot. ed.), 1896, Lloyd, Mycolog. Notes, Vol. I, p. 33, 1900. See also: Saccardo, Fries, Gillet, Stevenson, Massee, Ricken, Mcllvaine, Moffatt, etc.

COPRINUS. Massee, Revision of the Genus Coprinus: Ann. Bot., Vol. 10, p. 123, 1896. Daniels, E. A., Coprinus: Boston Mycolog. Club Bull. No. 15 and 16. See also: Saccardo, Fries, Stevenson, Patouillard, Massee, Gillet, Ricken, Atkinson, Peck's Reports, Moffatt, etc.

CORTINARIUS. Fries, Monographia Cortinariorum Sueciae, Upsala, 1851. Bataille, Flore Monographigue des Cortinaires d'Europe, Besancon, 1911. Kauffman, The Genus Cortinarius, Bull. Torr. Bot. Club, Vol. 32, pp. 301, 1905; The Genus Cortinarius with Key to Species, Jour. Mycol., Vol. 13, p. 32, 1907; Cortinarius as a Mycorhiza-producing Fungus, Bot Gaz., Vol. 42, p. 208, 1906. Earle, A Key to the North American Species of Cortinarius, Torreya, Vol. 2, pp. 169 and 180. Britzelmayer, M., Revision der Diagnosen zu den von Britzelmayr aufgestellten Hymenomyceten-arten, Bot. Centralblatt, Vol. 73, p. 129, 169 and 203, 1898. Maire, R., Notes critiques * * * * Bul. de la Soc. Myc. de France, Vol. 27, p. 423, 1911; Notes critiques * * * ibid, Vol. 26, p. 176, 1910. See also: Saccardo, Gillet, Quelet, Stevenson, Massee, Ricken, Boudier, Karsten, Michael, Peck (N. Y. State Reports) Hard, etc.

CREPIDOTUS. Peck, N. Y. State Mus. Rep. 39, p. 69, 1886. See also: Saccardo, Fries, Gillet, Patouillard, Ricken, Massee, Stevenson, Moffatt, etc.

DECONICA. See Psilocybe.

ECCILIA. See: Saccardo, Fries, Ricken, Moffatt, Peck's Reports, Atkinson (Preliminary Notes on Some New Species: Jour. Mycol., Vol. 8, p. 113, 1902), etc.

ENTOLOMA. Peck, N. Y. State Mus. Bull. 131, p. 47, 1909. See also: Saccardo, Fries, Gillet, Stevenson, Ricken, Mcllvaine, Hard, Atkinson, Moffatt, Morgan, Davis, etc.

FLAMMULA. Peck, N. Y. Mus. Rep. 50, p. 133, 1897. See also: Saccardo, Fries, Gillet, Stevenson, Ricken, Atkinson, Moffat, etc.

GALERA. Peck, N. Y. State Mus. Rep. 46, p. 61, (Bot. ed.) 1893. See also: Saccardo, Fries, Gillet, Ricken, Stevenson, etc.

GOMPHIDIUS. See: Saccardo, Fries, Ricken, Peck's Reports, etc.

HEBELOMA. Peck, N. Y. State Mus. Bull. 139, p. 67 (Bot. ed.), 1910. See also: Saccardo, Fries, Ricken, Stevenson, Massee, etc.

HYGROPHORUS. Peck, N. Y. State Mus. Bull. 116, p. 45, (Bot. ed.), 1907. Bataille, Flora Monographique des Hygrophores, Besancon, 1910. See also: Saccardo, Fries, Gillet, Schroeter, Ricken, Stevenson, Massee, Hard, Mcllvaine, Atkinson, Moffat, Davis, etc.

HYPHOLOMA. Peck, N. Y. State Mus. Bull. 150, p. 73 (Bot. ed.), 1911. Harper, Species of Hypholoma * * * * Trans. Wis. Acad. Sci. Arts, and Let., Vol. 17, p. 1142, 1914. Morgan, North American Species of Agaricaceae; Hypholoma, Jour. Myc., Vol. 14, p. 27, 1908. See also: Saccardo, Fries, Ricken, Atkinson, Moffatt, etc.

INOCYBE. Peck, N. Y. State Mus. Bull. 139, p. 48 (Bot. ed.), 1910. Massee, Monograph of the Genus Inocybe, Ann. Bot., Vol. 18, p. 459, 1904. Bresadola, Fungi Tridentini. See also: Patouillard, Saccardo, Gillet, Ricken, Hard, Moffatt, Davis, etc.

LACTARIUS. Peck, N. Y. State Mus. Rep. 38, p. Ill, 1885. Burlingham, Lactariae of the United States, Mem. Torr. Bot. Club, Vol. 14, p. 1, 1908. See also: Saccardo, Fries, Gillet, Bresadola, Ricken, Massee, Stevenson, Mcllvaine, Hard, Atkinson, Moffat, Morgan, Michael, etc.

LENTINUS. Peck, N. Y. State Mus. Bull. 131, p. 42, 1909. See also: Saccardo, Fries, Stevenson, Bresadola, Patouillard, Mcllvaine, Hard, Moffat, etc.

LEPIOTA. Peck, N. Y. State Mus. Rep. 35, p. 150, 1884. Quelet et Bataille, Flore Monographique des Amanites et des Lepiotes, Paris, 1902. Morgan, North American Species of Lepiota: Jour. Myc., Vol. 12, p. 154, 195 and 242, 1906; Vol. 13, p. 1, 1907. Lloyd, Myc. Notes, Vol. I, p. 4, 1898. Beardslee, The Lepiotas of Sweden: Jour. Myc., Vol. 13, p. 26, 1907. See also: Saccardo, Fries, Gillet, Barla, Bresadola, Ricken, Schroeter, Stevenson, Massee, Mcllvaine, Hard, Atkinson, Moffatt, Michael, etc.

LEPTONIA. See: Saccardo, Ricken, Stevenson, etc.

MARASMIUS. Morgan, North American Species of Marasmius: Jour. My col., Vol. II, p. 201, 1905. Pennington, N. Y. State Mus. Bull., 1915. See also: Saccardo, Fries, Stevenson, Massee, Patouillard, Ricken, Hard, Moffatt, etc.

MYCENA. Peck, N. Y. State Cab. Rep. 23, p. 80 (Bot. ed.) 1872. See also: Saccardo, Fries, Massee, Stevenson, Gillet, Ricken, Bresadola, Patouillard, Atkinson, Hard, Moffatt, etc.

NAUCORIA. Peck, N. Y. State Cab. Rep. 23, p. 91 (Bot. ed.), 1872. See also: Saccardo, Fries, Ricken, Moffat. etc.

NOLANEA. See: Saccardo, Fries, Gillet, Ricken, Stevenson, etc.

OMPHALIA. Peck, N. Y. State Mus. Rep. 45, p. 32; (Bot. ed.), 1893. See also: Saccardo, Fries, Stevenson, Ricken, Patouillard, Hard, Moffat, etc.

PANOEOLUS. Morgan, North American Species of Agaricaceae; Panoeolus: Jour. Myc., Vol. 13, p. 59, 1907. See also: Saccardo, Fries, Ricken, Atkinson, Hard, Peck's Reports, etc.

PANUS. Forster, Agarics of United States Panus: Jour. Mycol., Vol. 4, p. 21, 1888. See also: Saccardo, Fries, Stevenson, Mcllvaine, Hard, etc.

PAXILLUS. See Atkinson, Hard, Saccardo, etc.

PHOLIOTA. Peck, N. Y. State Mus. Bull. 122, p. 141, 1908. Harper, Species of Pholiota * * * * Trans. Wis. Acad. Sci. Arts and Let., Vol. 17, p. 470. See also: Saccardo, Fries, Gillet, Ricken, Hard, Atkinson, Mcllvaine, Moffat, etc.

PLEUROTUS. Peck, N. Y. State Mus. Rep. 39, p. 58, 1886. Webster, Bull. Boston Myc. Club, No. 8, 1898. See also: Saccardo, Fries, Gillet, Stevenson, Massee, Ricken, Patouillard, Atkinson, Mcllvaine, Hard, Moffatt, etc.

PLUTEOLUS. Peck, N. Y. State Mus. Rep. 46, p. 58, 1893. See also: Saccardo.

PLUTEUS. Peck, N. Y. State Mus. Rep. 38, p. 133, 1885. Lloyd, Myc. Notes, Vol. I, p. 12. See also: Saccardo, Fries, Stevenson, Ricken, Patouillard, Atkinson, Hard, etc.

PSALLIOTA. Peck, N. Y. State Mus. Rep. 36, p. 41, 1884. Smith, Rhodora, Vol. 1, p. 161. Lloyd, Myc. Notes, Vol. 1, p. 25, 1899. (These are given as Agaricus.) See also: (under Agaricus), Saccardo, Fries, Gillet, Ricken, Stevenson, Atkinson, Mcllvaine, Hard, Moffatt, etc.

PSATHYRA. Peck, N. Y. State Mus. Bull. 150, p. 84 (Bot. ed.), 1911. Morgan, Jour. Myc., Vol. 13, p. 147, 1907. See also: Saccardo, Fries, Ricken, etc.

PSATHYRELLA. Peck, N. Y. State Cab. Rep. 23, p. 102 (Bot. ed.), 1872. Morgan, Jour. Myc., Vol. 13, p. 54, 1907. See also: Saccardo, Fries, Ricken, etc.

PSILOCYBE. Peck, N. Y. State Mus. Bull. 157, p. 94 (Bot. ed.), 1912. Morgan, Jour. Myc., Vol. 13, p. 246, 1907. See also: Saccardo, Fries, Ricken, etc.

RUSSULA. Peck, N. Y. State Mus. Bull. 116, p. 67, 1907. Kauffman, C. H., Mich. Acad. Sci. Rep. 11, p. 57, 1909; Ibid, Rep. 13, p. 220, 1911. Kaufmann, F., Die bei Elbing gefundenen essbaren u. giftigen Tüublinge (Russula): Schriften der Naturforschenden Ges. in Danzig, N. F., Vol. 8, p. 21, 1894. Maire, Les bases de la classification dans le genre Russula, Bull, de la Soc. Myc. de France, Vol. 26, p. 49, 1910. Notes critiques * * * * Ibid., p. 167. Peltereaux, Etudes et Observations sur les Russules: Bull, de la Soc. Myc. de France, Vol. 24, p. 95, 1908. Battaille, Flore monographique des Asterospores, 1907. Barbier, Encore les Russules: Bull, de la Soc. Myc. de France, Vol. 24, p. 230, 1908. Romell, Lindblads Svampbok, p. 62. Hymenomycetes of Lapland: Arkiv för Botanik, Vol. II, No. 3, p. 5, footnotes. Denniston, Trans. Wis. Acad. Sci. Arts & Let., Vol. 15, p. 71. Macadam, Jour. Mycol., Vol. 5, p. 58 and 135, 1889. See also: Saccardo, Fries, Gillet, Quelet, Massee, Stevenson, Ricken, Mcllvaine, Burlingham, etc.

STROPHARIA. Harper, Species * * * * in the Region of the Great Lakes: Trans. Wis. Acad. Sci. Arts and Let., Vol. 17, p. 1014, 1913, Morgan, North American Species of Agaricaceae: Jour. Myc., Vol. 14, p. 57, 1908. See also: Peck's Reports, Saccardo, Fries, Gillet, Stevenson, Ricken, Hard, Atkinson, etc.

TRICHOLOMA. Peck, N. Y. State Mus. Rep. 44, p. 150, 1891. See also: Saccardo, Fries, Gillet, Barla, Ricken, Stevenson, Massee, Mcllvaine, Hard, Moffatt, Morgan, etc.

TUBARIA. See: Saccardo, Fries, Stevenson, etc.

VOLVARIA. Lloyd, Volvae of United States, p. 10, 1898. See also: Saccardo, Fries, Patouillard, Ricken, Peck's Reports, Hard, etc.

AUTHORITIES AND ABBREVIATIONS

The binomial botanical name of each plant is followed by an abbreviation, e. g. Fr., which refers to the person who named the species. According to the rule established by the International Congress at Brussels in 1910, no names are to be considered valid in the case of the Agarics, earlier than those, published in the Systema Mycologica of Fries, 1821-1832. In case the name was used for the same species by someone before Fries, reference may be made to it thus: Fr. (ex. Pers.).

AUTHORS OF AGARICS

A. & S.	Albertini and Schweinitz.
Atk.	Atkinson, Geo. F. (U. S.).
B. & C.	Berkeley and Curtis.
B. & Br.	Berkeley and Broome.
Bann.	Banning, Mary E. (U. S.)
Barla.	Barla, J. B. (France).
Batsch.	Batsch, Augustus (German).
Beards.	*Beardslee, H. C. (U. S.).
Berk.	Berkeley, Rev. J. M. (England).
Bolt.	Bolton, James (Canada).
Boud.	*Boudier, E. (France).
Bosc.	Bosc, Louis (U. S.).
Bres.	*Bresadola, Abbe J. (Austria).
Britz.	*Britzelmayr, Max (Germany).
Bull.	Bulliard, Pierre (France).
Burl.	*Burlingham, Gertrude S. (U. S.).
Cke.	Cooke, M. C. (England).
Clem.	*Clements, F. C. (U. S.).
Curt.	Curtis, Rev. M. A. (U. S.).
D. C.	DeCandolle, Augustin P. (Switzerland).
E. & E.	Ellis and Everhart.
Earle.	*Earle, F. S. (U. S.).
Ell.	Ellis, J. B. (U. S.).
Fr.	Fries, Elias Magnus (Sweden).
Frost.	Frost, Charles C. (U. S.).
Gill.	Gillet, C. C. (France).
Henn.	Hennings, Paul (Germany).
Herbst.	Herbst, Wm. (U. S.).
Kalchb.	Kalchbreuner, Karoly (Hungary).
Karst.	*Karsten, P. A. (Finland).
Kauff.	*Kauffman, C. H. (U. S.).
Kromb.	Krombholz (Germany).
L. or Linn.	Linneaus, Carl von (Sweden).
Lev.	Leveille, Joseph H. (France).
Lindb.	Lindblad, M. A. (Sweden).
Lloyd.	*Lloyd, C. G. (U. S.).
Longyear.	*Longyear, B. O. (U. S.).
Maire.	*Maire, Rene (France).
Mass.	Massee, Geo. (England).
Mont.	Montagne, Camille (France).
Morg.	Morgan, A. P. (U. S.).

Murr.	*Murrill, Wm. E. (U. S.).
Pat.	*Patouillard, N. (France).
Pers.	Persoon, Christian Hendrick (Europe).
Pk.	Peck, Charles Horton (U. S.).
Q. & S.	Quelet and Schulzer.
Quel.	Quelet, L. (France).
Rav.	Ravenel, W. H. (U. S.).
Ricken.	*Ricken, Rev. Adelbert (Germany).
Rom.	*Romell, Lars (Sweden).
Roze.	Roze, Ernest (France).
Sacc.	*Saccardo, P. A. (Italy).
Schaeff.	Schaeffer, Jacobi C. (Germany).
Schroet.	Schroeter, Julius (Germany).
Schw.	Schweinitz, Rev. Louis David de (U. S.).
Schulz.	Schulzer, von Muggenberg (Europe).
Scop.	Scopoli, Giovanni A. (Italy).
Sec.	Secretan (Switzerland).
Smith.	Smith, W. G. (England).
Sow.	Sowerby, James (England).
Vahl.	Vahl, Martin (Norway).
Vitt.	Vittadini, Carlo (Italy).

Those names which are starred are living mycologists.

MISCELLANEOUS ABBREVIATIONS

Acad.	Academy.
Bot.	Botanical.
Bull.	Bulletin; a publication.
Cab.	Cabinet.
Cm.	Centimetre.
Fig.	Figure, referring to an illustration.
Gaz.	Gazette.
Hist.	History.
Jour.	Journal.
Mem.	Memoir, a publication.
Micr.	Micron, one thousandth of a millimeter.
Mm.	Millimetre.
Mus.	Museum.
Myc.	Mycology, Mycological.
Nat.	Natural, Nature.
No.	Number of a figure or plate.
Op.	Opposite (page).
p.	Page.
Pl.	Plate; referring to illustration.
Rep.	Report; a publication.
Ridg.	Ridgway's Color Standards, 1912.
Sci.	Science.
Soc.	Society.
Sp. nov.	New Species; described for first time by the writer.
Var.	Variety.

GLOSSARY

ABERRANT, differing from a certain species, genus, etc, in some respects, but not easily placed in another species, genus, etc.

ABNORMAL, (of a specimen), not properly developed.

ABORTIVE, (of a fruit-body or its parts), not perfect or entirely lacking.

ABRUPT, (of a stem), terminating suddenly.

ABRUPTLY-BULBOUS, (of the bulb of a stem), not rounded above.

ACICULAR, (of a stem or cystidia), bristle-shaped, very slender.

ACICULATE, same as acicular.

ACRID, (of the taste of a mushroom or its juices), biting on the tongue.

ACUMINATE, (of cystidia, or the ends of a lamella), gradually narrowed to a point.

ACUTE, (of cystidia or the edge of the gills), pointed; less than a right-angle; sharp-edged; not prolonged.

ADNATE, (of gills), see Fig. 1, 2; also (of the pellicle, scales, etc.), not capable of being peeled off or easily detached.

ADNEXED, (of gills), see Fig. 1, 4, narrowly attached to the stem.

AFFINITY, (of a species, genus, etc.), closely related by natural characters.

AERUGINOSE, (color), verdigris-green.

AERUGINOUS, same as aeruginose.

AGGLUTINATE, (of fibrils, hairs, etc.), as if. glued together in tufts.

AGGREGATE, crowded close together.

ALLANTOID, (of spores), sausage-shaped.

ALLIACEOUS, (odor), like onions or garlic.

ALUTACEOUS, (color), light leather colored; isabelline; pale tan.

ALVEOLATE, (of the surface of pileus or stem), deeply pitted.

AMBIGUOUS, (of a species, genus, etc.), doubtful as to its place in classification.

AMYGDALINE, (odor or taste), like that of peach or cherry stones, cherry-bark, etc.

ANALOGOUS, similar in form, structure or appearance, but not necessarily related to.

ANASTOMOSING, (of gills, ridges, wrinkles, etc.), connecting crosswise, so as to form angular areas or pits bounded by the connecting gills, etc.

ANGULAE, (of spores), not regular in outline, not rounded; (of scales or pileus), when formed by cracking of cuticle, etc.

ANNULATE, (of stem), bearing an annulus.

ANNULAE, (of remains of veil on stem), resembling a ring.

ANNULUS, the encircling band or curtain on the stem, resulting from the loosening of the inner veil from the margin of the pileus. See Fig. 2, 5.

ANOMALOUS, deviating from the general rule.

ANTERIOR, (of gills), the end of the gills at the margin of the pileus; in front.

APICAL, (of stem), the portion near the pileus; referring to the apex.

APICULUS, (of spores), the short, often sharp papilla at one end of a spore, by which it was attached to the sterigma.

APICULATE, provided with an apiculus.

APPENDICULATE, (of margin of pileus), hung with fragments of the veil.

APPLANATE, (of pileus), flattened out or horizontally expanded.

APPRESSED, (of scales, fibrils, hairs, etc.), closely flattened down; same as adpressed.

APPROXIMATE, (of gills), free from but approaching the stem; closely; not remote.

ARACHNOID, (of the partial veil), cobweb-like.

ARCUATE, (of gills or margin of pileus), curved like a bow.

ARCUATE-DECURRENT, (of gills), extending down the stem.

AREOLATE, (of surface of pileus or stem), arranged in little areas.

ARGILLACEOUS, (color), clay color, resembling ochraceous-cinamon-brown.

ARID, (of gills), dry, somewhat parchment-like.

AROMATIC, (odor), of an agreeable aroma, reminding of drags.

ASCENDING, (of gills), in the case of a conical-shaped or unexpanded pileus.

ASTRINGENT, (taste), causing more or less contraction or "pucker" of mouth membranes.

ATOMATE, (surface of pileus or stem), covered with minute, shining, point-like particles.

ATTENUATE, (of stem), gradually narrowed and thinner.

AURANTIACOUS, (color), of an orange color.

AUREOUS, (color), golden-yellow, reddish-yellow.

AXIS, (of stem), the central, interior portion.

AZONATE, (of surface of pileus), not zoned.

BASAL, (of stem), at the lower end.

BASIDIOMYCETES, see page 26.

BASIDIUM, (of gills), one of the large cells which collectively compose the hymenium and which bear each four spores.

BEADED, (of gills), applied to the row of drops exuding from the edge of gills.

BEHIND, (of gills), toward the stem.

BI—, of two, or twice.

BIBULOUS, (of surface of pileus), capable of absorbing moisture.

BIFURCATE, (of gills), forking by two's.

BISTRE, (color), blackish-brown.

BIOLOGY, the science of living organisms.

BIOLOGICAL, concerning the life of plants or animals.

BLOOM, (of pileus or stem), a minutely velvety surface.

BROAD, (of gills), a relative term, opposed to narrow; determined by experience.

BUFF, (color), pale creamy-gray.

BULBOUS, (of stem), enlarged at base. (See also "abruptly-bulbous", clavate-bulbous and round-bulbous.)

BULBILLATE, (of stem), provided with a small or obscure bulb.

BULLATE, (of pileus), with a rounded knob.

BYSSOID, (of mycelium), the condition when fine filaments spread from the base of the stem or fruit-body over the substratum.

CAESIOUS, (color), pale bluish-gray.

CAESPITOSE, aggregated in tufts but not grown together.

CAMPANULATE, (of pileus), bell-shaped of similar.

CANALICULATE, (of stem), furrowed or fluted.

CANDIDOUS, (color), shining-white.

CANESCENT, (surface), covered with hoary down.

CAP, the pileus.

CAPILLARY, (of stem), hair-like.

CAPITATE, (of cystidia), with a minute knob at the tapering apex.

CARBONACEOUS, (of tissue), of the texture of charcoal.

CARINATE, (of spores), furnished with a keel, boat-shaped.

CAENEOUS, (of trama), fleshy.

CARTILAGINOUS, (of stem, cortex or cuticle), tough-brittle, breaking with a snap.

CAULICOLOUS, growing on herbaceous stems.

CELL, (of fungi), the living, protoplasmic units into which the mycelium and hyphae are divided.

CERACEOUS, waxy.

CEREBROSE, (of surface of pileus), convoluted like a brain.

CHLAMYDOSPORES, (see secondary spores), thick-walled spores developed from hyphae but not on basidia.

CINEREOUS, (color), ashy-gray.

CINNABAR, (color), verminion, red.

CINNAMON, (color), cinnamon-brown.

CIRCUMSCISSILE, (of volva). See page 593.

CITRINE, lemon-yellow.

CLAVATE, (of stem), thickened toward base, like a club; (of basidia and cystidia), thickened at apex, club-shaped.

CLAVATE-BULBOUS, (of stem), with a bulb which tapers gradually upwards.

CLAY-COLOR, argillaceous.

CLOSE, (of gills), halfway between crowded and subdistant; a relative term.

COBWEBBY, (of veil), composed of threads fine as those of a cobweb.

COCHLEATE, (of pileus), twisted like a shell.

COERULEOUS, (color), sky-blue.

COHERENT, (of stems), grown together.

COMPRESSED, (of stem), flattened lengthwise.

CONCAVE, (of pileus), round-depressed like a bowl.

CONCENTRIC, (of zonation, etc.), rings or zones within one another in a series.

CONCHATE, (of pileus), resembling an oyster shell in shape.

CONCOLOR, (of gills and stem), when of the same color as the pileus.

CONCOLOROUS, same as concolor.

CONFLUENT, (of flesh of stem), continuous with trama of pileus and of similar texture.

CONGLOBATE, (of base of stems), collected into a fleshy mass.

CONIDIUM, (see secondary spores), thin-walled spores developed on mycelium or on the hyphae of the fruit-body.

CONIDIA, plural of conidium.

CONIDIAL, relating to conidia.

CONIDIOPHORE, the specialized hypha bearing a conidium.

CONIFER, mostly evergreen trees bearing cones.

CONIFEROUS, said of forests or wood of conifer trees.

CONNATE, (of stems), grown together.

CONNIVENT, (of margin of pileus), converging on the stem.

CONSISTENCY, the firmness, density or solidity of the tissues which compose the parts of the fruit-body.

CONTEXT, the trama.

CONTINUOUS, (of stem), same as confluent.

CONVEX, (of pileus), regularly rounded, broadly obtuse, etc.

CONVEXO-PLANE, (of pileus), changing from convex when younger to flat when expanded.

CONVEX-EXPANDED, (of pileus), changing from convex and tending towards plane; the margin often remaining decurved.

CONVERGENT, (of trama of gills), in section the hyphae are seen to turn inwards to a median line.

CONVOLUTE, same as cerebrose.

CORIACEOUS, of a leathery texture.

CORNEOUS, of a horny texture.

CORRUGATE, (surface), coarsely wrinkled.

CORTEX, (of stem), the outer, denser rind.

CORTICAL, referring to the cortex.

CORTICATE, possessing a cortex.

CORTINA, the inner or partial veil in some genera of Agarics, the structure of which is cobwebby.

CORTINATE, provided with a cortina, or (of stem) covered by the threads of the cortina.

COSTATE, (of gills, etc.), veined or ribbed.

COTTONY, (of surface), covered by a soft cotton-like substance.

CRENATE, (of edge of gills or margin of pileus), scalloped.

CRENULATE, very finely crenate.

CRETACEOUS, (of color or consistency), like chalk.

CRISPED, (of gills), finely wavy.

CROWDED, (of gills), almost touching one another.

CRUCIATE, (of spores), having the general form of a cross.

CRYPTOGAMS, the group of plants which reproduce by spores and which include the fungi.

CRYPTOGAMIC, relating to cryptogams.

CUCULLATE, (of pileus), shape of a "high hat."

CUNEATE, (of pileus), wedge-shape.

CUSPIDATE, (of pileus or cystidia), tipped with a prominent sharp protuberance.

CUTICLE, (of pileus or stem), a differentiated thin layer of hyphae on the surface; same as pellicle.

CYATHIFORM, (of pileus), cup-shaped or bowl-shaped, flaring above.

CYLINDRICAL, (of stem or spores), of the same diameter throughout its length.

CYSTIDIUM, (of hymenium of gills), mixed with the basidia and usually projecting beyond them; large sterile cells.

CYSTIDIA, plural of cystidium.

DECORTICATED, of dead wood destitute of the bark.

DECUMBENT, (of stem), with the lower end lying against the substratum.

DECURRENT, (of gills), descending on the stem, see Fig. 1, (3).

DECURVED, (of margin of pileus), bent down.

DEBRIS, the mixture of fallen leaves, twigs, wood, etc., covering a forest floor.

DEFLEXED, same as decurved.

DELIQUESCENT, (of gills), absorbing water and dissolving at maturity.

DENTATE, (of gills), toothed on the edge.

DENTICULATE, (of gills), finely dentate.

DENUDED, (of pileus and stem), naked or glabrous by removal of the scales, flocci, etc.

DEPAUPERATE, undeveloped because of lack of favorable conditions.

DEPRESSED, (of pileus), central portion lower than margin.

DETERMINATE, having a fixed, definite limit.

DETERMINATION, assigning a plant to its correct place in the classification.

DIAGNOSIS, a distinctive description of a plant.

DIAPHANOUS, transparent or nearly so.

DICHOTOMOUS, (of gills), repeatedly forking in pairs.

DIFFERENTIATED, applied to portions or tissues of different character, all derived from a homogeneous tissue.

DIFFORMED, irregular in form.

DILATED, (of stem), enlarged.

DILUTE, (of color), reduced in strength.

DIMIDIATE, (of pileus), semicircular in outline, (of gills), that reach only half-way to stem.

DISK, (of pileus), the central portion of the surface.

DISCOID, (of pileus), with a noticeably marked, flattened disk.

DISCRETE, (of veil, scales, etc.), separate, not grown fast to and continuous with the surface.

DISTANT, (of gills), set far apart, especially toward the margin of the pileus; a relative term.

DIVERGENT, (of trama of gills), in section, the hyphae are seen to turn outwards from a median line.

DORSAL, (of pileus), the upper, back side.

DOWNY, (of pileus and stem), composed of fine hairiness.

DRY, not viscid nor hygrophanous.

EBENEOUS, (color), black as ebony.

EBURNEOUS, (color), white like ivory.

ECCENTRIC, (of stem), not attached in the center.

ECHINATE, (of scales, etc.), sharply pointed spines.

ECHINULATE, (of spores, etc.), with minute and finely pointed spines.

ELEVATED, (of pileus), raised up at the margin.

ELLIPTICAL, (of spores, young pileus, gills, etc.), longer than broad, usually more than twice as long as broad and curved in outline.

ELLIPTIC, ELLIPSOID and ELLIPSOIDAL, similar to elliptical.

EMARGINATE, (of gills), notched near the stem. See Fig. 1, (6).

ENTIRE, (of gills), edge not toothed, etc.

EPIDERMIS, see cuticle.

EPISPORE, the outer wall of a spore.

EPIPHYTAL, growing on leaves.

EQUAL, (of stein), of uniform diameter; (of gills), alike in length.

ERODED, (of gills), edge as if gnawed.

EROSE, same as eroded.

ESCULENT, edible, can be eaten.

EVANESCENT, (of veil, annulus, scales, etc), but slightly developed and soon disappearing.

EVEN, (of surface of pileus, stem, spores), without striations, elevations, depressions or unevenesses of any kind. Compare glabrous and smooth.

EXCENTRIC, see eccentric.

EXOTIC, foreign, not native.

EXPANDED, (of pileus), the opening out of the cap while maturing or ageing.

EXSICATTI, dried specimens kept in herbaria, often in sets.

"FAIRY RINGS," mushrooms appearing in circles. See page 4.

FAMILY, a term in classification, each family includes related genera; the scientific ending of a family name is *aceae*.

FALCATE, (of spores), sickle-shaped.

FARINACEOUS, (odor and taste), like fresh meal; (of pileus and stem), covered by mealy particles.

FARINOSE, like farinaceous.

FASCIATED, (of stems, pilei, etc.), grown together so that tissues are intimately continuous.

FASCICULATE, (of fibrils, scales, stems, etc.), crowded in bundles.

FERRUGINOUS, (color), rusty-red.

FIBRILLOSE, (of surface of cap and stem), provided with fibrils or clusters of small fibres composed of hyphae.

FIBROUS, (of flesh of stem), composed of toughish, string-like tissue.

FILAMENT, a thread, applied to the separate threads of the mycelium.

FILAMENTOUS, composed of filaments.

FILIFORM, (of stem), slender as a thread.

FIMBRIATE, (of gills), with the edge minutely fringed, due to presence of cystidia or sterile cells.

FISTULOSE, (of stem), tubular.

FLABELLIFORM, (of pileus), fan-shaped.

FLACCID, flabby; soft and limber; without firmness or elasticity.

FLARING, (of volva or annulus), spreading away from stem at upper margin.

FLAYESCENT, (color), becoming yellowish.

FLAVUS, (color), of Saccardo's Color Key; a light cadmium-yellow.

FLESH, the trama of the mushroom, especially of the pileus and gills.

FLESHY, of rather soft consistency, putrescent; as opposed to leathery, corky, woody, membranous, etc., referring to the consistency of the trama of most of the Agarics.

FLEXUOUS, (of stem), bent in an undulate manner.

FLOCCI, (of pileus or stem), small points or tufts resembling cotton.

FLOCCOSE, (of pileus or stem), provided with cottony substance on the surface.

FLOCCULOSE, finely floccose.

FLOCCULOSE-CRENULATE, (of gills), edge with minute flocculose decoration.

FOETID, (odor), ill-smelling, nauseating.

FRIABLE, easily crumbled or breaking into powder.

FREE, (of gills), not attached to the stem at any time.

FRONDOSE, said of a forest or the wood of broad-leaved trees.

FRONT, (of gills), the end toward the margin of the pileus; anterior.

FRUIT-BODY, the term applied to the mushroom as opposed to the mycelium.

FRUCTIFICATION, the fruit-body.

FUGACIOUS, disappearing early or quickly or (of color) fading soon.

FULIGINOUS, (color), smoky, sooty.

FULVESCENT, (color), becoming fulvous.

FULVOUS, (color), of Saccardo's Color Key; reddish-cinnamon-brown.

FUNGUS, applied to the individuals of a group of plants which lack the green chlorophyll and hence subsist on other plants, plant-remains or animals; they vegetate in the form of mycelium, and their fruit-bodies are also composed of mycelioid tissue.

FUNGI, the plural of fungus.

FURCATE, (of gills), forked.

FURFURACEOUS, (of pileus or stem), covered with bran-like particles; scurfy.

FUSCESENT, (color), becoming fuscous.

FUSCOUS, (color), a smoky drab; see Ridgway's Color Standards (1912). The term has been used in this report in a wider sense, including paler shades with more brown in them.

FUSIFORM, (of stem and spores), spindle-shaped.

GELATINOUS, jelly-like, applied to tissue whose hyphae become partially dissolved and glutinous in wet weather and when mounted in water under the microscope appear more transparent and wider, loosening from one another.

GENERIC, of the rank of a genus.

GENUS, a term in classification; each genus includes certain related species; the two names, viz. of its genus and its species, compose the binomial by which a plant is known in science, e. g. Psalliota campestrls.

GIBBOUS, (of pileus), with an unsymmetrical convexity or umbo, or with convexity on one side.

GILLS, the knife-blade-like structures on the underside of the pileus; lamellae; collectively, the hymenophore.

GILL-TRAMA, the tissue of a gill between the two hymenial layers.

GILVOUS, (color), yellowish leather colored.

GLABRESCENT, becoming glabrous.

GLABROUS, (of pileus and stem), surface destitute of scales, hairs, etc., smooth.

GLANDULAR, with sticky drops or glands.

GLAUCOUS, (of pileus), covered with fine white bloom, easily rubbed off.

GLOBOSE, spherical or almost so.

GLUTEN, (of cuticle of pileus or stem, of universal veil), the dissolved gelatinous hyphae of certain tissues; very sticky and toughish.

GLUTINOUS, provided with gluten.

GRANULAR, (of pileus or stem), covered with granule-like substance.

GRANULOSE, same as granular.

GREGARIOUS, growing in company, scattered closely over a small area.

GROUP, a general term, applied indefinitely to a large or small number of plants whether classified or not.

GUTTATE, (of pileus), spotted as if by drops of liquid.

GUTTULATE, (of spores), containing an oily globule.

HABIT, the manner of growth of a plant.

HABITAT, the natural place of growth of a plant.

HAIRY, (of pileus), covered by an arrangement of fibrils resembling hairs.

HERBACEOUS, said of those flowering plants which perish annually down to the roots.

HERBARIUM, a collection of dried plants arranged systematically.

HETEROGENEOUS, applied to a structure composed of unlike tissues.

HIRSUTE, (of pileus), covered with rather long stiff fibres or hairs.

HISPID, (of pileus), covered with stiff bristle-like hairs.

HOARY, (of pileus or stem), covered with dense silky down; cane-scent.

HOMOGENEOUS, applied to structures composed of uniform tissues.

HOST, the plant or animal on or in which a parasitic fungus exists.

HUE, (of color), used here indiscriminately for "tint" or "shade." See Ridgway's Color Standards (1912) page 17, for correct usage.

HUMUS, the mixture of decayed vegetation and soil in the forest.

HYALINE, (of spores, gluten, etc.), colorless; transparent.

HYGROPHANOUS, (of flesh of mushrooms, or surface of pileus), watery in appearance, like the "water-core" of an apple, moisture disappearing rapidly accompanied by change in color, usually by fading.

HYGROSCOPIC, readily absorbing moisture from the atmosphere.

HYMENIUM, aggregation of the basidia in a continuous layer mixed with cystidia or sterile cells when present; the spore-bearing layer.

HYMENOMYCETES, the group of fungi possessing a hymenium composed of basidia which are exposed.

HYMENOPHORE, the portion of the fruit-body bearing the hymenium.

HYPHAE, plural of hypha; same as mycelium, composing also the fruit-body.

ICONES, colored plates illustrating fungi.

IDENTIFICATION, the study of the characters of a plant in order to determine its name.

IMBRICATE, (of pilei), overlapping one another, like the shingles of a roof.

INCARNATE, (color), flesh-colored.

INCISED, (of margin of pileus), as if cut into.

INCOMPLETE, (of annulus), forming a partial ring.

INCRASSATE, (of stem), thickened.

INCURVED, (of margin of pileus), same as inflexed.

INDIGENOUS, native, not foreign.

INFERIOR, (of annulus), below the middle of the stem.

INFLATED, (of cystidia), swollen like a bladder.

INFUNDIBULIFORM, (of pileus), funnel-shaped.

INNATE, (of scales, fibrils, etc.), a part of the surface tissue, not superficial.

INSERTED, (of base of stem), attached directly without "roots" or fibrils; instititious.

INSTITITIOUS, same as inserted.

INTERSPACES, (of gills), spaces between the attachment of the gills to the pileus.

INTERVENOSE, (of gills), veined in the interspaces.

INTERWOVEN, (of trama), intermingled arrangement of hyphae, not parallel, convergent nor divergent.

INTRODUCED, brought from another country and growing spontaneously.

INVOLUTE, (of margin of pileus), rolled in, especially when young.

ISABELLINE, same as alutaceous; pale tan-color.

LABYRINTHIFORM, of sinuous lines; like a labyrinth.

LACERATE, (of annulus, scales, pileus, etc.), as if torn.

LACINIATE, (of margin of annulus or pileus), cut coarser than fimbriate; slashed.

LACTIFEROUS, (of hyphae of trama), bearing a milky juice.

LACUNOSE, (of pileus or stem), covered with pits or indentations.

LAMELLAE, plural of lamella; same as gills.

LANATE, same as woolly.

LANCEOLATE, (of spores, cystidia or gills), lance shaped; many times longer than broad, and tapering.

LATEX, a juice, usually of milky color, but also applied to other colors.

LATERAL, (of stem), attached to one side of the pileus.

LENS, a hand magnifying glass.

LIGNATILE, growing on wood.

LIGNICOLOUS, same as lignatile.

LINGULATE, (of pileus), tongue-shaped.

LIVID, (color), like that of a bruise; bluish-black.

LOBED, (of pileus), with rather large, rounded divisions on the margin.

LUCID, clear to the understanding; transparent.

LURID, (color), smoky-reddish, sordid.

LUTEOUS, (color), dull egg-yellow; see Saccardo's Color Key.

LUTESCENT, (color), becoming luteous.

MACROSCOPIC, visible without magnification.

MACULATE, spotted.

MAMMIFORM, (of umbo), breast-shaped.

MARGINATE, (of pileus), with a distinctly marked border; (of bulb), with a circular ridge on the exterior upper angle where the universal veil was attached.

MARGINATE-DEPRESSED, (of bulb), provided with a narrow, circular, horizontal platform on the upper side.

MAST, the fruit of forest trees like acorns and nuts, often used of a heap of nuts.

MATRIX, the substance on or in which a fungus grows,

MILKY, of the color of milk.

MEDIAL, (of annulus), situated at or near the middle of the stem.

MEMBRANOUS, (of pileus, annulus, etc.), thin and pliant like a membrane; applied when the trama of pileus is quite thin.

MEMBRANACEOUS, same as membranous.

MICACEOUS, (of pileus), covered with glistening mica-like particles.

MIXED, referring to forests containing both conifer and broad-leaved trees.

MILD, (odor and taste), not with a distinctly marked peculiarity.

MICROSCOPIC, of a size requiring the use of a microscope to see clearly.

MICROSCOPICAL, same as microscopic.

MICRON, (measure), of the length of one-thousandth part of a millimetre; used to designate size as measured by the use of a microscope.

MICROMETER, a disc of glass ruled with lines forming a metric scale for measuring objects under the microscope in microns.

MICRO-CHEMICAL, referring to tests with chemicals on microscopic objects.

MOLDS or MOULDS, certain fungi whose vegetative growth appears mouldy.

MONSTROSITY, applied to a specimen of a very abnormal appearance.

MORPHOLOGICAL, pertaining to form and structure, often used in a phylogenetic sense.

MOVABLE, (annulus), that can be moved more or less easily up and down the stem.

MUCILAGINOUS, slimy.

MUCCOUS, slime.

MUSHROOM, a general term applied to the fleshy Agarics and fleshy species of other fungi; a mushroom may be edible, poisonous, unpalatable, tough, etc., but popular usage applies the term only to edible ones. See toadstool.

MYC., MYCET., MYCETO., MYCO., prefixes signifying fungus.

MYCELIUM, came as hyphae; the vegetative part of a fungus consisting of microscopic threads usually with cross-walls to form the cells which contain the living protoplasm.

MYCELEOID, (of base of stem), provided with a white mouldy growth of mycelium.

MYCOLOGICAL, relating to mycology.

MYCOLOGY, the term applied to the science dealing with fungi.

MYCOPHAGIST, one who eats mushrooms; an epicure concerning mushrooms.

MYCOLOGIST, one who is versed in mycology; a specialist in the study of fungi.

MYCORHIZA, the stunted rootlets of trees, when such rootlets are covered or permeated by the mycelium of fungi.

NAKED, (of pileus or stem), entirely devoid of fibrils, scales or other covering.

NARROW, (of gills), a relative term, the opposite of broad; determined by experience.

NIGRESCENT, (color), turning blackish.

NUCLEATE, (of spores), containing microscopically visible, oil-like globules.

OBCLAVATE, (of cystidia, spores, stem), a reversal of clavate.

OBCONIC, reversal of conic.

OBLONG, (of spores), twice as long as wide.

OBOVATE, (of spores, etc.), reversal of ovate.

OBSOLETE, (of annulus, scales, etc.), very imperfectly developed, hardly perceptible; (of terms), no longer in use.

OBTUSE, (of pileus, cystidia, spores), rounded or blunt; greater than a right angle.

OCHRACEOUS, (color), dingy ochre-yellowish.

OCHREATE, (of volva), sheathing the stem at base like a stocking.

OLIVACEOUS, (color), with an olive shade.

OPAQUE, dull, not shining.

ORBICULAR, (of pileus), circular in outline.

OVAL, (of young pileus, spores), having the shape of an egg.

OVATE, similar to oval but rather pointed at the narrower end.

OVOID, same as oval.

PALLID, (color), of an indefinite pale or whitish appearance.

PAPILLA, a small, nipple-shaped elevation.

PAPILLATE, (of pileus or spores), provided on surface with papillae.

PARALLEL, (of trama of gills), in section the hyphae lie continuously side by side.

PARASITE, an organism living upon another live organism and deriving food from it, with or without fatal effect.

PARTIAL VEIL, the inner veil, extending from the margin of the pileus to the stem. See page 4.

PATCHES, (of scales or remnants of the universal veil), flat, closely applied pieces.

PECTINATE, (of margin of pileus), resembling the teeth of a comb.

PEDICEL, (of cystidia) a slender stalk.

PELLICLE, same as cuticle, sometimes thought of as thinner and more definite.

PELLICULOSE, provided with a pellicle.

PELLUCID, translucent.

PELLUCID-STRIATE, (of pileus), when as the result of the thinness of the pileus the gills become visible thru it and appear as striae.

PENTAGONAL, (of spores), angular and five-sided.

PERIPHERY, the outer boundary or surface.

PERONATE, (of stem), booted; sheathed by the volva or universal veil.

PERONATE-SCALY, (of stem), when the sheath of a peronate stem is broken up and the parts persist.

PERSISTENT, retaining its place, shape or structure, not disappearing.

PETALOID, (of pileus), shaped like the petal of a flower, narrowed somewhat at base.

PHYLOGENETIC, pertaining to phylogeny.

PHYLOGENY, the history of the evolution of the group or race to which a species belongs.

PILEATE, possessing a pileus.

PILEI, the plural of pileus.

PILEUS, the cap or that structure of an Agaric which bears the gills on its under side.

PILOSE, (of pileus), covered with long, soft, hairy filaments.

PIPSHAPED, (of spores), shape of an apple seed.

PITTED, (of pileus or stem), similar to lacunose; with little depressions.

PITH, (of stem), the soft tissue in the interior, which often disappears so that the stem becomes hollow.

PLANE, (of pileus), with a flat surface.

PLIANT, not rigid nor firm; easily bent.

PLICATE, (of pileus), plaited; folded like a fan.

PLUMBEOUS, (color), like lead.

PLUMOSE, finely feathery.

POROSE, (of hymenophore), approaching the condition of possessing pores.

POSTERIOR, (of gills), behind, toward the stem.

PRAEMORSE, (of the "root" or base of stem), as if broken off abruptly.

PROLIFEROUS, (of stem), producing other stems on itself near the base.

PROTEAN, exceedingly variable.

PROTOPLASM, the living semifluid substance of the cells which is the basis of life.

PRUINATE, same as pruinose.

PRUINOSE, (on the surface), as if finely powdered.

PSEUDOPARENCHYMA, the tissue of fungi when its cellular structure imitates the parenchyma of higher plants.

PSEUDOPROSENCHYMA, tissue of fine elongated hyphae, somewhat resembling the prosenchyma of higher plants.

PUBESCENCE, a covering of short, soft, downy hairs.

PUBESCENT, provided with pubescence.

PULVERULENT, covered as if with powder.

PUNCTATE, (of pileus or stem), dotted with minute scales or other substance.

PUTRESCENT, soon decaying and becoming soft and mushy.

PYRIFORM, (of cystidia or cells), pear-shaped.

PYRAMIDAL, (of scales), pyramid-shaped.

QUADRATE, (of spores), angularly four-sided.

RADICATING, (of stem), imitating a root,

RAMIFICATION, branching.

REFLEXED, (of margin of pileus), turned up or back.

REMOTE, (of gills), free and at some distance from the stem; (of annulus), at some distance from apex of stem.

RENIFORM, (of pileus), kidney-shaped.

REPAND, (of pileus), wavy on margin and turned back or elevated.

RESUPINATE, (of pileus), with the upper surface reclining on the substratum, the gills facing outward.

RESUPINATE-REFLEXED, (of pileus), attached for some distance by the back surface, the other portion extending out like a shelf.

RETICULATE, (of pileus or stem), marked by lines, veins or ridges which cross one another as in a net.

REVIVING, said of a fruit-body which shrivels in dry weather and takes on its natural shape when wet.

REVOLUTE, (of margin of pileus), rolled back or up.

RHIZOIDS, radiating hyphae extending into substratum from base of stem.

RHIZOMORPHS, visible strands or cords of compacted mycelium, often dark colored, penetrating a soft substratum or between portions of it, as between bark and wood, etc.

RIMOSE, (of pileus), cracked.

RIND, same as cortex.

RING, same as annulus.

RIVULOSE, (of pileus and stem), marked with lines like a river-system on a map.

ROOTING, (of stem), an attenuated prolongation into the soil or substratum.

ROUND-BULBOUS, of a bulb not marginate.

RUFESCENT, (color), becoming reddish.

RUFOUS, (color), reddish, dull red.

RUGOSE, coarsely wrinkled.

RUGULOSE, finely wrinkled.

SACCATE, (of cystidia), shape of a meal-bag.

SANGUINEOUS, (color), blood-red.

SAPROPHYTE, a plant which lives on dead vegetable or animal matter.

SCABROUS, (of pileus), rough with short, rigid projections.

SCALES, applied to various decorations on the pileus and stem; torn portions of the cuticle or of the universal veil or of the volva; they may be membranous, fibrillose, hairy, floccose, hard, erect, flat, patch-like, etc.; often an important feature for identification.

SCALY, provided with scales.

SCLEROTIA, resting-bodies of small size, composed of a hardened mass of hyphae, from which fruit-bodies may develop.

SCISSILE, (of flesh of pileus), capable of being pulled into horizontal layers; this condition is most marked in a hygrophanous pileus.

SECEDE, (of gills), when at first attached to stem, i. e. adnate or adnexed, but separating from it later.

SECONDAEY SPORES, not borne on basidia; conidia, chlamydospores, etc.; formed directly on the mycelium or on hyphae of the fruit body.

SEPARABLE, (of cuticle, pellicle, etc.), not adnate.

SEPARATING, see secede.

SERICEOUS, silky.

SERRATE, (of gills), with saw-tooth-like edge.

SERRULATE, minutely serrate.

SERRATULATE, same as serrulate.

SESSILE, (of pileus), without a stein.

SETACEOUS, (of stem), bristle-form.

SHAGGY, rough with long compact fibrils.

SILKY, covered with shining, close-fitting fibrils.

SINUATE, (of gills), a concave indentation of its edge near the stem.

SINUOUS, wavy, serpentine.

SLENDER, (of stem), very long as compared to its thickness; relative to stout.

SMOOTH, (of spores), not spiny, tuberculate, rough, nor angular, etc; (of pilus and stem), see glabrous.

SOLITARY, not growing in the immediate neighborhood of other individuals.

SOLID, (of stem), not hollow nor stuffed; of a texture in its central axis similar to that found in the rest of a cross-section.

SORDID, (color), dirty or dingy.

SPADICEOUS, (color), date-brown.

SPATHULATE, (of pileus), spatula-shaped; oblong with attenuated base.

SPECIES, the lowest term in classification; a group of individuals agreeing in certain characters which appear again in their progeny; one species differs from another in several marked characters agreed upon as sufficiently specific by tradition or by specialists in the group; a species is therefore a judgment, and has limitations imposed by an agreement of the judgments of scientific men. One or more species with certain common characters constitute a genus.

SPECIFIC, referring to characters which are used in designating or distinguishing species.

SPHAGNUM, a genus of mosses; bog-moss.

SPINY, (of spores), strongly echinulate.

SPHOEROID, (of spores), nearly spherical; similar to spherical.

SPONGY, (of stem), soft and tending to be water-soaked.

SPONGY-STUFFED, (of stem), with a spongy pith.

SPORE, the reproductive cells in Agarics borne four on each basidium; more accurately called basidio-spores. In other cryptogams the term is applied to reproductive cells or bodies of a great variety of kinds. The basidio-spores when they germinate give rise to mycelium.

SPOROPHORE, fruit-body.

SPURIOUS, false.

SQUAMOSE, (of pileus or stem), covered with scales.

SQUAMULOSE, minutely squamose.

SQUAMULE, scale.

SQUARROSE, (of pileus and stem), covered with recurved scales.

STAINED, said of any part which appears as if some coloring matter had been spilled on it and spread on the surface.

STALK, an indefinite term for stem, pedicel, etc.

STELLATE, (of spores, scales), with extensions like that of a star.

STERIGMA, the tiny spicule-like extension at the apex of a basidium on which the spores develop.

STERILE, said of a fruit-body or hymenium which is immature or produces no spores; or simply, without spores.

STERILE CELLS, term applied in this report to the slender cells on the edge of gills which bear no spores and which cause the fimbriate appearance of the edge as shown under a lens.

STIPE, technical term for the stem of mushrooms; see stem.

STIPITATE, possessing a stem.

STOUT, (of stem), relative to slender; not so many times longer than thick.

STRAIGHT, (margin of pileus), when not incurved.

STRAMINEOUS, straw-color.

STRIATE, (of margin of pileus), radiating minute furrows or lines; (of stem), longitudinal lines or minute furrows.

STRIAE, the lines or furrows when striate.

STRIGOSE, (of pileus or stem), with coarse or thick, long, rather stiff hairs.

STUFFED, (of stein), when the axis is filled with a differentiated pith which usually disappears in age leaving it hollow.

SUB—, prefix signifying "almost," "somewhat" or "under."

SUBGENUS, a term in classification; a grouping under a genus and containing groups of related species. The subgenera of the mycologists of one generation are often raised to the rank of genera by later students.

SUBICULUM, a more or less dense felt of hyphae covering the substratum, from which the fruit-bodies arise.

SUBDISTANT, (of gills), the spacing halfway between close and distant.

SUBDECURRENT, (of gills), when the attachment extends slightly farther down the stem than when adnate.

SUBHYMENIUM, a differentiated tissue just beneath the hymenium.

SUBSTRATUM, the substance in or on which the fungus grows, as soil, humus, fallen leaves, dung, wood, animal remains, etc. A better term than matrix.

SUBULATE, awl-shaped.

SULCATE, (of pileus and stem), grooved, more extreme than striate, less so than plicate.

SUPERFICIAL, (of scales, flocci, etc.), on the surface and easily removable.

SUPERIOR, (of annulus), attached above the middle of the stem.

SYNONYM, the name or names of a species or genus no longer tenable, either because of error in naming, rearrangement of the classification or as a result of "rules" promulgated by scientific men acting in agreement. Many of the long known plants have a number of such synonyms.

TAN, (color), leather-colored, similar to undressed leather; isabelline.

TENACIOUS, tough.

TERETE, (of stem), round like a broom-handle, not irregular.

TERRESTRIAL, growing on the ground.

TESTACEOUS, (color), brick-red.

TEXTURE, the arrangement of the components of the different tissues, as compact, loose, etc.

TINGED, with a tint of a color.

TISSUE, an aggregate of similar cells or hyphae.

TOADSTOOL, same as mushroom; popularly applied to those about which the user of the term often has no knowledge and which lie therefore considers poisonous; a large number of so-called "toadstools" are edible.

TOMENTOSE, (of pileus or stem), densely covered with a matted wooliness or tomentum.

TOMENTUM, composed of long, soft, entangled or matted fibrils.

TOXIC, poisonous.

TOOTH, (of gills), decurrent by a tooth; see uncinate.

TRAMA, the fleshy portion of pileus or gills composed of hyphae.

TRANSLUCENT, capable of transmitting light without being transparent.

TRANSVERSE, cross-wise.

TREMELLOID, of a gelatinous consistency.

TRUNCATE, an enlarged portion ending as if cut off.

TUBERCLE, any wart-like or knob-like excrescence.

TUBERCULATE, (of spores), covered with minute tubercles.

TUBERCULAR-STRIATE, (of pileus), when the striae are roughened by small tubercles.

TUMID, (of stem), swollen, inflated.

TURBINATE, (of pileus), top-shaped.

TYPE, the original specimen or specimens from which the species was described and named.

TYPICAL, agreeing with the descriptions of the type or with the type itself.

UMBER, (color), almost tobacco-colored; see Saccardo's Color Key.

UMBILICATE, (of pileus), with a central, naval-like depression.

UMBILICUS, a naval-like depression.

UMBO, (of pileus), a raised, conical to convex knob or mound on the center.

UMBONATE, (of pileus), provided with an umbo.

UNCINATE, (of gills), provided with a narrow, decurrent extension at the stem.

UNDULATE, same as wavy.

UNEQUAL, (of gills), of different length, some reaching the stem, others shorter.

UNEVEN, (of pileus or stem), said of surfaces with striations, reticulations, tubercles, etc.; not even.

UNICOLOROUS, of the same color throughout.

UNIVERSAL VEIL, sometimes used for volva.

VAGINATE, (of stem), provided with a long volva or sheath at the lower end.

VARIABILITY, the state of being variable.

VARIABLE, capable of taking on a number of different shapes, forms, colors or other characters, while retaining its specific identity.

VARIEGATED, marked with a variety of colors, which are intermingled.

VARIETY, (a). Here used to refer to a form which a species constantly assumes, under definite conditions, e. g. climate, soil, artificial culture, etc. Such forms are often given names, as *Psalliota compestris* var. *hortensis*.
(b). Also used to designate forms which are not typical, but which are not sufficiently known to be designated by a specific name; such are given the name of the nearest species in this report followed by the abbreviation "var."
(c). When a variety is found to be constant in its characters and always distinct in some such characters from other species, it should eventually be given a specific name, but in rare varieties such constancy is not easily proven.

VEIL, see "partial veil," "universal veil," "cortina" and "volva."

VEINED, (of gills), with vein-like wrinkles or raised lines on the surfaces.

VELUM, see veil.

VENOSE, same as veined.

VENTRAL, on the under side of, opposed to dorsal.

VENTRICOSE, (of stem), swollen or enlarged in the middle.

VERRUCOSE, warty.

VERRUCULOSE, minutely warty.

VESICULOSE, referring to the trama of the Lactariae. See page 83.

VILLOSE, covered with long, soft, weak hairs.

VINACEOUS, (color), of the color of red wine.

VIOLACEOUS, (color), of some violet hue.

VIRESCENT, (color), becoming greenish.

VIRGATE, (of pileus), streaked, usually by differently colored fibrils.

VISCID, sticky.

VISCOUS, gluey.

VITELLINE, (color), egg-yellow.

VOLVA, the universal veil of certain genera. See pages 4 and 593.

WARTY, (of pileus, spores, etc.), covered by small wart-like excrescences.

WAVY, (of margin of pileus), alternately raised and depressed like waves.

WAXY, (of gills), of a consistency that can be partially or wholly moulded or compressed into balls.

ZONATE, (of pileus), marked with concentric bands of color.

ZONED, same as zonate.