KENTUCKY

AGRICULTURAL EXPERIMENT STATION

OF THE

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BULLETIN No. 96.

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KENTUCKY
Agricultural Experiment Station.

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ADDRESS:
KENTUCKY AGRICULTURAL EXPERIMENT STATION,
LEXINGTON, KY.

Bulletin No. 96.

1. The Hessian Fly.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

Since the recent advance in the price of wheat this crop has become a favorite with Kentucky farmers and the acreage sown has steadily increased. With this increasing acreage, there has been a growing abundance of the Hessian fly. Last year's sowing suffered especially, owing to a prolonged period of mild weather at the time of planting. Probably very little of what was sown in some localities escaped injury. This injury suffered by late-sown wheat has led some farmers to become sceptical as to the advantage resulting from late planting.

The scepticism is unwarranted by the facts, when all are known and considered. It is well enough understood here that when cold weather comes, and especially after a few very heavy frosts, the adult mosquitoes that frequent dwellings disappear. The Hessian fly is a very similiar insect. It is somewhat smaller, but has the same general form, long and slender legs, etc. As an adult, it does not endure cold any better than a mosquito, and the fact explains why delaying planting as long as practicable results in less injury to wheat. The adult Hessian flies have simply placed their eggs on other wheat and have perished before the late-planted wheat came up.

Close observation of the fly at Lexington this season shows that the insect does not emerge from the old stubble in large numbers during the summer. It appears normally to æstivate in the soil, lying dormant until about wheat planting time, when most of the brood emerges, during about a week of time, place the eggs promptly, and disappear. A quantity of infested stubble kept in the Vivarium of this Division did not yield the fly until fall, although the jars were kept moist, and the conditions provided were not so very different from those prevailing in the fields. Other stubble brought to the Vivarium on September 21 still contained the fly in the flax seed stage. From both lots of stubble the flies began to emerge in numbers on October 1. By October 3, these flies had placed their eggs and died. But for some days subsequently flies continued to emerge and thus a few adults were alive at the Station on October 13. Field work carried on during the same period and later showed that belated flies emerged out of doors subsequent to this date, as will appear in what follows.

WHEN THE EGGS ARE LAID.

With a view to deciding definitely the length of time during which the female Hessian fly is abroad placing her eggs, plots of wheat were this year planted on the Experiment Farm at intervals of a week, beginning on September 26. The full result of the experiments cannot now be obtained, but facts of interest to farmers have been secured that may be presented, and treated more fully later.

The first eggs were secured October 2, at the Station. The first planting of wheat was up at that time. A female distended with eggs was obtained October 3 by Mr. Richmond, assistant in the Division, by sweeping stubble left from badly infested wheat.

October 21, the young maggots, still showing the red color of the egg-contents, were found behind the leaf sheaths of this wheat, some down near the joint (node), others at various distances above. A few were white and larger than the others.

October 26, wheat planted October 10 was examined, and eggs were found on the blades.

November 1, wheat planted October 17 was examined, and a few eggs were found on 4 out of 38 plants. This wheat was not up October 26; hence the eggs were laid sometime between this date and November 1.

The fact of most importance brought out by these plantings is that some adult flies are abroad after October 26. The local Weather Bureau Station recorded a light frost on September 19, another October 5, and a heavy frost, on October 3, 14, 15 and 25. Two light frosts and four heavy ones had thus preceded the laying of the eggs found on the wheat planted October 17. Of course cold weather may sometimes retard the hatching of Hessian fly eggs, but our Weather Station records a mean temperature for the last week of October of 60° F., the lowest being 37° F. on October 25.

It is too early to determine the relative injuiry in these plots of wheat, because the eggs have but lately been laid in some, and may not result in young fly. Yet it is altogether probable that an examination of 100 plants from each plot foreshadows what will prove true from later and more thoroughgoing examinations. These plants were taken at random November 6.

Plot one, planted September 26, yielded 33 per cent. of infested plants.

Plot 2, planted October 3, yielded 1 per cent. of infested plants.

Plots 3, 4 and 5 planted, respectively, October 10, 17 and 24, yielded no infested plants.

The adult fly is a very fragile insect, and lasts but a short time after emerging and laying its eggs. But unless weather becomes very severe after wheat is planted and the temperature remains low, it appears that some belated flies escape the early frosts and come out of the ground on warm days succeeding. The average temperature for October was 58° F., just what it was for this month in 1900, and one degree warmer than the average for October during the last 14 years. There

is some ground for the presumption therefore that during some seasons the adult fly would not be abroad after the middle of October.

But in any case the experiment shows *that to escape severe injury from the fly it is not safe to plant wheat in this part of Kentucky before the third of October.* Farther south in the State, the fifteenth of October, or even the first of November, where a stand can be secured, would be better.

THE FLY.

Several inquiries recently received by me from wheat growers indicate that the Hessian fly in any but the flax seed stage is not well known to practical men. Twice during October, packages containing a small beetle (*Aphodius inquinatus*) were received, with the inquiry as to whether or not it was the adult fly. These beetles are very common during October, and attract attention because of their habit of rising in the air over wheat fields towards evenings of warm afternoons. They belong to an entirely different insect order from the Hessian fly and have nothing to do with the injury suffered by wheat.

As already stated the adult fly is a very small gnat resembling in general shape a mosquito, but lacking the beak of the latter insect. When any one asserts that he has observed this insect swarming in fields, one may be sure he has mistaken some other insect, such as the little beetle mentioned, for the Hessian fly. The flies appear to cling pretty closely about the plants during the day, and very careful search for them by sweeping the young plants and the stubble of infested wheat, at a time when they were undoubtedly abroad in large numbers, has failed to secure more than two or three.

The eggs are so small that it is hardly worth while to look for them except with a hand magnifier. Still it was found that when they were located with the lens and one thus became familiar with their appearance, they could be recognized as long, slender, red objects, lying in the grooves of the wheat blades. By holding a blade up to the sunlight they could be detected afterward by a pair of good eyes, without the aid of a lens. Only a few eggs are placed on a single blade and plant, in the field.

But when confined, a single female may place all of those laid by her on such plants as may be provided. In one instance a female confined at the Station placed 64 eggs on two young wheat plants growing in a flower pot. These were invariably, as they were in the field, on the upper sides of the blades, in the small longitudinal grooves. In some cases a half dozen were placed together in a single groove, end to end, in others but one was noted in a place. They were scattered in this instance over much of the lengths of the blades, some being placed near the tips, others near the bases. In the field they were generally found 2 or 3 together on the lower halves of the blades.

Quite often the flax seeds (puparia) of the Hessian fly are spoken of by farmers as the "eggs." They do look like the eggs of some insects, but not at all like those of the fly. They are the resting stage of the insect, between the grub and adult stages. It must be remembered that the egg of the Hessian fly is always found exposed on the upper sides of the blades, never under the sheaths at the base of the plant, and that it is only to be found on the blades during the fall, and again for a short period in spring, when the winter brood has emerged as adults and is laying eggs for a second brood to carry the species through the summer.

Eggs obtained October 3 measured just 0.50 millimeter (0.02 inch) in length, by 0.07 millimeter in diameter. They were cylindrical, smooth, rounded at the tips, sometimes curved a little ; color, light red.

The flax seed or puparium, on the other hand, measures 4 millimeters (0.16 inch) long, and 1.25 millimeter in diameter, being 8 times longer than the egg and every way larger.

The following table gives the data dealt with above in condensed shape. The figures with reference to temperature were kindly copied for me by Mr. W. E. Gary from records kept by the local Weather Station :

Date.	*Max.*	*Min.*	*Mean.*	*Frosts.*	*Hessian Fly.*
SEP.					
26	79	59	69		
27	76	54	65		
28	64	57	60		
29	77	62	70		
30	67	55	61		
OCT.					
1	79	56	68		1st adults.
2	70	50	60		
3	58	39	48	Heavy	Eggs and adults.
4	60	41	50		
5	64	40	52	Light	
6	68	43	56		
7	73	44	58		
8	74	50	62		
9	65	54	60		
10	76	56	66		
11	78	55	66		
12	67	54	60		
13	60	44	52		Eggs and adults.
14	51	38	44	Heavy	
15	69	42	56	Heavy	
17	56	39	48		
18	57	36	46		
19	73	43	58		
20	72	52	62		
21	74	50	62		Eggs on wheat planted Sept. 26.
22	74	52	63		
23	79	52	66		
24	70	46	58		
25	60	37	46	Heavy	
26	69	44	56		Eggs on wheat planted Oct. 10.
27	71	47	59		
28	76	54	65		
29	78	54	66		
30	76	55	66		
31	73	52	62		
Nov.					
1	66	52	59		Eggs on wheat planted Oct. 17.

2. Dangerous Mosquitoes in Kentucky.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

The suffering ordinarily caused by mosquitoes furnishes sufficient reason for giving them attention in these bulletins were they incapable of any other mischief. But it has been proved of late that they are carriers of disease, of some of the most dreaded diseases, being possibly in some cases the sole agents by which the diseases are disseminated among men. If investigators in the employ of our own and foreign governments are right, some of these insects convey the parasites causing malaria, others convey yellow fever from ill to well, and in eastern countries still others carry in their bodies the small worm which introduced into the human body causes the disease known as filariasis or elephantiasis. The convincing evidence as to the part taken by these insects has only recently been secured. But it has long been recognized that insects of various sorts convey disease from one plant to another, and it has been suspected that human diseases, smallpox, scarlatina, measles, and others, may be carried by common household insects.

The proof that diseases to which we are subject may be conveyed by insects renders the diseases much less dangerous to us than they have been, because a knowledge of the truth will enable us to avoid them better than has hitherto been possible. But since outbreaks of such diseases as yellow fever come as the wind blows, information concerning them cannot be spread abroad too promptly or freely. To some extent the isolation of the farmer is a protection against infectious and contagious diseases. During outbreaks, cities and villages become centers of greatest virulence, and often the farmer has only to stay at home to avoid infection. This is especially true of yellow fever. He has more to fear from malaria, which, once established on a farm, is likely to persist thereafter

as long as swamps, ponds, or streams, in the vicinity furnish suitable breeding places for the peculiar mosquitoes that serve to carry malaria parasites.

MALARIA AND MOSQUITOES.

In 1880, Laveran, a surgeon in the French army, discovered in the small discoid blood corpuscles of malarial patients, foreign objects that had the appearance of belonging to the lowest animal group, the Protozoa. He named it *Oscillaria malariæ*, but it has since become widely known in medical and other literature as *Plasmodium malariæ*. Thorough study with the microscope has shown Laveran's discovery to be a parasite, which with others since discovered, constitutes a family group to which the name Hæmamœbidæ has been applied. In a recent paper published (1900) by Major Ross and Dr. Fielding-Ould in the British Quarterly Journal of Microscopical Science, the parasites concerned in producing the group of diseases known as malaria are placed in two genera,* Hæmamœba and Hœmamœnas, the latter containing a crescent-shaped parasite occurring in the blood of persons attacked by the dangerous tropical or autumnal fever. In addition to to this crescentic parasite, two other distinct species are now recognized, associated respectively with 3-day (tertian) and 4-day (quartan) ague.

The Parasites.—To one not accustomed to the use of a compound microscope it is difficult to convey an idea of the small single-celled animal that has attained so much prominence among scientific and medical writers. To say that it is a minute mass of living jelly, capable to some slight extent of changing form, and under some circumstances of giving off small bodies (amœbulæ) which may acquire thread like processes by which they move freely, is to say about all that is worth saying of its structure and development in

* Dr. M. Luhe (Centr. Bakt. u Par., 1900, p 436) has recently reviewed the subject, and concludes that the old genus Plasmodium must stand. The names of the species should, he thinks, be: *Plasmodium malariæ*, Laveran (of Quartana); *P. vivax*, Grassi and Feletti (of Tertiana); *P. præcox*, Grassi and Feletti (of Perniciosa).

this connection. Really quite a complicated little life-history has been worked out for each of the three parasites, the details of which may be omitted here as of interest mainly to the specialist. The important fact for us, and it has now been established with a good degree of certainty, is that little bodies (amœbulæ) given off by these parasites are the migrating buds by which the parasite is disseminated.

But how do they make their way into the blood of healthy human beings? It has long been well known that somehow living in the vicinity of swamps is likely to lead to intermittent fevers, and the term malaria itself implies a contaminated atmosphere, it having been assumed that some emanation from decaying vegetable matter present in such situations was responsible for the trouble. Within the past five years I have heard a trusted physician assert that these fevers were the result of "miasma" by which he meant bad air from swamp land. Bacteria and their like he held in contempt as the creations of disordered minds.

Miasma Not the Cause of Ague.—It has been proved quite recently that a man may live in the most notoriously malarious regions in the world and enjoy perfect immunity from intermittent fevers, while people all about him are suffering from them, provided he stays in doors at night shielded from emanations given off by surrounding swamps only by wire gauze on open windows and doors. He may go abroad freely during the day, actually living in the swamps and breathing all the time the "miasmatic" air, yet remain in perfect health. His freedom from disease is due to the fact that the parasites mentioned above as living in our blood are sucked up by mosquitoes belonging to the genus Anopheles, and after undergoing some changes in the bodies of these insects are discharged into the blood of those who may later be attacked by the infected insects. Since the insects are active at night while their victims sleep, the presence of wire gauze on doors and windows keeps the disease away.

While the reason for this protection, and proof that it is such, are recent aquisitions, a belief that occupants of houses closed at night with close-meshed wire gauze or mosquito bar

were exempt from malaria has been current in some parts of the world for many years. Dr. Nuttall in his review of literature relating to insects as carriers of disease mentions several medical writers who claimed during the early part of the nineteenth century that veils and other cloth coverings employed at night warded off the disease, and quotes Oldham as authority for the statement that certain hunting and fishing natives of India wrap themselves from head to foot in a fabric of some sort and thus protected spend the nights in boats among the reeds of marshes, without suffering any harm. All these facts and beliefs are now to be accepted as confirming the results of recent experimental work done on the notoriously malarious Roman Campagna by Doctors Sambon and Low of the London School of Tropical Medicine. These gentlemen, as has been frequently stated of late in newspapers and other periodical literature, constructed in the latter part of 1900, in one of the worst parts of the Campagna, a mosquito-proof house in which they dwelt, going indoors each evening at six o'clock and remaining there until the next morning. During the day time these men went abroad as did everybody else in the vicinity, exposing themselves in every way to infection, even allowing themselves to be drenched to the skin with rain, yet were never attacked by malaria. The malaria mosquitoes were observed by them to come each night and endeavor to get through the wire gauze with which the windows and doors of the house were guarded. The experiments, and those of Italian investigators, have been so widely made known that it is unnecessary to go further into details than to state the additional fact that malaria has now been produced in people who had never before been attacked by the disease and were at the time of taking it living in a non-malarious region, simply by allowing them to be stung by a mosquito of the genus Anopheles that had previously sucked blood from a person suffering from the disease.

MOSQUITOES WHICH CONVEY MALARIA.

The common mosquito of dwellings in Kentucky does not carry the parasite which causes intermittent fevers. It has

been exceptionally abundant during the two or three years past, at Lexington, yet malaria is not a common disease here, indeed is not common taking the State as a whole, and as compared, for example with the swampy region about Charleston, South Carolina. Our mosquito is active at all times during the day, and continues active when lamps are lighted in the evening. During moonlight nights it may prove annoying in bedrooms, but it requires some light, and its attacks may be almost entirely avoided at night by darkening sleeping apartments. It remains about dwellings and out-houses at all times after becoming adult, and undoubtedly passes the winter there.

The malaria mosquitoes, on the other hand, are not active during the day time, enter dwellings only at night, and while individuals are sometimes found upon the walls of rooms during the day, they are probably in most cases those that have failed to find their way out again when day appeared, or are such as have been rendered sluggish from engorging themselves with blood. They appear, in short, to be insects of the primitive woods and marshes, which prowl around human abodes at night much as does the coyote and other wild beasts in thinly settled countries. Our ordinary mosquito is as much at home about dwellings as is the common housefly.

Occasionally mosquitoes of the genus Anopheles are to be found in houses about Lexington, but are relatively rare insects, are very shy, show not the slightest disposition to attack during the day, and in all probability not one man in 25,000 has has ever seen one to know it. We have two species of the genus, both of which are larger than the common mosquito, and have longer legs. They can be recognized when at rest by the fact that they are disposed to lift the abdomen in such a way that it forms a straight line with the beak; sometimes the abdomen is elevated so as to give the insect an appearance of standing on its head after the manner of an acrobat. In all ordinary mosquitoes the abdomen is held parallel with the surfaces upon which they rest, and there is an abrupt downward descent along the front of the thorax to the head. These differences of posture are quite characteristic, and will

enable one to recognize members of the two genera more readily perhaps than anything else.

It happens that both of our species have the wings marked with black, while none of the common species are so marked. In one of them this character is liable to be obscured in old individuals by the wings becoming worn. Another character separating the malaria mosquitoes from the others is more important than those mentioned, but unfortunately is not so easily made out. At each side of the beak in the female of the common mosquitoes is a short, jointed feeler (palpus), less than a fourth of the length of the beak. In the malaria mosquitoes this structure is about as long as the beak.

TWO KENTUCKY SPECIES OF ANOPHELES.

The two species thus far observed in this State are described below in as simple language as possible, with a view to aiding in their recognition where they occur. It is probable that at least one additional species will be found here, and I shall be under obligations to any one who will send species of the genus to the Station from his locality, simply placing them alive in a vial and enclosing this, packed in cotton, in a small box.

Anopheles punctipennis, Say.—Length of body, one-fourth inch; wing also one fourth inch long; beak a little less than one-eighth inch long. Legs very long. Color in general blackish brown. Eyes green. Top of head between eyes with rather long gray hairs. Proboscis brown, except at extreme tip, which is whitish. Feelers (palpi) as long as the proboscis, brown, except tips, which are pale. Antennæ gray. Wings with much black, especially along the front margin, with two noticeable buff-yellow dots, one, larger, at the beginning of the outer three-fourths of the front margin; the other, smaller, near the tip. The black follows the veins chiefly, and is interrupted in places by pale regions. Thorax brown on the sides and beneath, with a well defined gray region extending the whole length of the upper (dorsal) side. Legs brown, excepting at the extreme tips of the femora and tibiæ, which are pale. Abdomen brown, with pale hairs; beneath, with a row of gray dots at each side.

This is one of our largest mosquitoes, and is to be known from any other species occurring here by the black and buff markings of its wings. When it alights it does not always elevate the abdomen, but is generally found with this division of the body held at a more or less decided angle from the surface on which it rests, the beak commonly projecting in a straight line with the rest of the body. It has in my experience proved a shy insect, being more difficult to capture than common mosquitoes, from its habit of darting off suddenly when one approaches. I have never seen an engorged specimen.

It hibernates as an adult in caves, being found there from September until January, associated in some cases with the brown mosquito known in the books as *Culex pungens*. A single individual has been obtained by me in a cellar in October, from which circumstance it is probable that it hibernates also in the cellars of country dwellings, as well as in crevices about cliffs.

Anopheles maculipennis, Meigen.—Length of body a little less than one-fourth inch; wing equaling body in length. Legs very long. Gray, obscurely marked. Eyes brown in preserved specimens, margined with pale above. Top of head between eyes with gray hairs, with a golden lustre in some lights. Proboscis black, with some pale hairs at tip. Feelers (palpi) as long as proboscis, black, with pale hairs at tips. Antennæ gray. Wings appearing unmarked in some specimens; in well preserved specimens with four very small black dots, one nearly central, another nearer the base and front margin; two other smaller ones about midway between the central dot and the apex of the wing. Thorax black, with gray hairs, showing golden in some positions. Legs black, the femora and tibiæ tipped with pale yellow. Abdomen with the divisions gray at the base, and black behind; everywhere with golden hairs.

A smaller insect than the preceding, and more obscurely colored. Likely to be mistaken for the ordinary mosquito, but assumes the characteristic posture when at rest, and possesses all the other characters of the genus. Observed by me

in dwellings at Lexington, but is not common. Have not collected it in caves.

BREEDING PLACES OF MALARIA MOSQUITOES.

The reason why these mosquitoes are more common in marshy country than elsewhere is because the young wrigglers live in water where they find an abundance of the green scum (algæ) that flourishes in marsh waters. But while they are always most abundant in such places, the young are known to occur also in small permanent pools and even in ditches if these afford them the right kind of food; and they may thus occur in larger or smaller numbers in most localities. They do not, however, commonly, live in rain barrels, tubs, and the like, with the young of common house-infesting mosquitoes, and we cannot therefore expect to avoid malaria by doing away with such breeding places about dwellings.

TREATMENT.

The best protection against these mosquitoes is wire screens on such doors and windows as must be kept open at night. If desirable, these may be removed during the day to allow a free circulation of air. In non-malarial regions such precautions are not absolutely necessary, even when the mosquitoes are present, since it is essential that the mosquitoes become contaminated before they can convey the disease. They become necessary at once, however, when a person affected with the disease comes into a neighborhood. In such case the proper procedure is of course to quarantine the sick, keeping him enclosed with wire screens during the night until he is cured. Unfortunately it is not always feasible to make one's self safe in this way, and until the laws require this simpler and better method, those who have a regard for their health must shield themselves from the attacks of the insects.

When malaria is about it is well to search the walls of rooms during the day to detect lurking individuals of Anopheles that by some chance have succeeded in entering in spite of screens.

Rubbing the skin with naphthaline, coal oil, or oil of pennyroyal, to some extent and for a time deters mosquito attacks, but can not be depended on entirely for malaria mosquitoes,

since it is not practicable to have these materials on the skin while one sleeps. When one is out in the woods, hunting or fishing, they will often serve a useful purpose.

Undesirable pools of water calculated to serve as breeding places for the young should always be disposed of by draining, filling or diking, as may be most expedient. Precautions of this sort are known to have afforded relief where mosquitoes had hitherto been so abundant as to render a region scarcely habitable.

Coal Oil on Water.—Much has been said in public journals about coal oil on the surface of stagnant water as a means of destroying young mosquitoes. Dr. L. O. Howard, who has advocated the use of the oil in this way, traces the suggestion back to 1812. He has satisfied himself that oil so used is effective. Where pools are not of value for stock or for fishes, probably coal oil might prove useful in lessening the number of mosquitoes. In Kentucky, where many farmers are at much pains to produce a pond for the convenience and comfort of stock, this use of oil is not to be considered, since to be effective it would be necessary to keep the surface covered much of the summer, and if no other injurious effect resulted it would be very likely to taint milk and butter produced by cows that drank the water.

YELLOW FEVER AND MOSQUITOES.

Work recently done by United States army surgeons in Cuba demonstrates not only that this disease can be conveyed by mosquitoes, but tends to prove that it is not commonly conveyed by any other agency. The results obtained by these men mark the most important advance yet made in a study of this disease. They have a special importance in Kentucky, liable as shown by its history to occasional local outbreaks of yellow fever, and at all times subject to danger from those who seek refuge here whenever the fever rages in the more southern states.

It seems that upon the recommendation of Surgeon General Sternberg, a medical board was appointed to study yellow fever in the Island of Cuba, consisting of Drs. Walter Reed,

James Carroll, Aristides Agramonte and Jesse W. Lazear. The attention of this board was directed especially to a study of the means by which the disease spreads. In reports made by the board during the past two years it has been shown that mosquitoes are agents by which the disease is transmitted, and although the parasite causing the disease is not yet known, have shown that one particular species of mosquito is the "intermediate host" for the yellow fever germ, just as species of Anopheles are for the malaria parasite.

Two members of the board, Drs. Lazear and Carroll, allowed themselves to be bitten by mosquitoes that had previously bitten yellow fever patients. Both became affected with the disease, the former losing his life as a result.

In a paper* read before the Pan-American Medical Congress at Havana, in February, 1901, the board reported as follows:

"Out of a total of 18 non-immunes whom we have inoculated with contaminated mosquitoes, since we began this line of investigation, 8, or 44.4 per cent. have contracted yellow fever. If we exclude those individuals bitten by mosquitoes that had been kept less than twelve days after contamination, and which were therefore probably incapable of conveying the disease, we have to record eight positive and two negative results—80 per cent."

Later, according to General Sternberg, Dr. Reed states that the board succeeded in conveying the disease to twelve persons by means of mosquitoes.

In the paper referred to above additional experiments are reported, showing that yellow fever is not conveyed by means of clothing and other objects used by fever patients. The report is a record of unobtrusive heroism, such as has not been surpassed in any period of the world's history.

The board had erected a frame house such that mosquitoes could not enter, and styled it "Building No. 1," or the "In-

*I am indebted to the kindness of General Sternberg for the privilege of seeing this paper, and also for a copy of General Sternberg's article entitled "The Transmission of Yellow Fever by Mosquitoes," published in the Popular Science Monthly, July, 1901.

fected Clothing and Bedding Building." On November 30, 1900, this building was provided with bedding soiled by contact with yellow fever patients at the Las Animas Hospital, Havana, and at Columbia Barracks, some of it purposely and freely soiled, and in the evening after unpacking it and shaking it in the air of the room to liberate the germs of yellow fever should any be present, Dr. R. P. Cooke and two privates of the hospital corps, all non-immune Americans, made up their beds of this clothing and slept there, continued to do so thereafter until December 19, 1900, adding to their equipment on December 12, bedding so offensive that its odor compelled them to retreat for a time from the house. Though spending 20 nights in this house, all three remained in good health. Subsequently other non-immune Americans occupied this building, using even undershirts that had been worn by yellow fever patients, and in not a single instance was yellow fever contracted.

In a second building, known as "Building No. 2, or the Infected Mosquito Building," all articles used were carefully disinfected by steam, after which infected mosquitoes were introduced. Comparing the results of experiments made in the two houses the board in the report referred to write: * * * "nothing can be more striking and instructive as bearing upon the cause of house infection in yellow fever than when we contrast the results obtained in our attempts to infect Buildings No. 1 and No. 2; for whereas, in the former *all* of seven non-immunes escaped the infection, although exposed to the most intimate contact with the fomites [soiled clothing] for an average period of twenty-one nights each; in the latter an exposure, reckoned by as many minutes, was quite sufficient to give an attack of yellow fever to one out of two person who entered the building—50 per cent,"

Under the head of conclusions the board presents the following:

"The mosquito—*C. fasciatus*—serves as the intermediate host of the parasite of yellow fever.

Yellow fever is transmitted to the non-immune individual

by means of the bite of the mosquito that has previously fed on the blood of those sick with the disease.

An interval of about twelve days or more after contamination appears to be necessary before the mosquito is capable of conveying the infection.

Yellow fever is not conveyed by fomites, and hence disinfection of articles of clothing, bedding, or merchandise, supposedly contaminated by contact with those sick with this disease, is unnecessary.

The spread of yellow fever can be most effectually controlled by measures directed to the destruction of mosquitoes and the protection of the sick against the bites of these insects.''

THE YELLOW FEVER MOSQUITO IN KENTUCKY.

The single species of mosquito used in the experiments of the board is referred to as *Culex fasciatus*. It is not only common in Cuba, but occurs everywhere in our southern states, and perhaps nowhere in greater abundance than here in Kentucky. It is our most common and annoying mosquito. In Bluegrass Kentucky so far as I know we are not troubled in doors by any other species, though one other besides the malaria mosquito, is known to me as a frequenter of buildings. It is the brown species known in the books as *Culex pungens*. It appears indoors, however, chiefly in the fall of the year, and I have never seen an engorged example there, nor one that showed any disposition to attack human beings.

The yellow fever mosquito is the small grey, house-infesting insect, with sharply white–banded legs. By this character it may be known from any other mosquito likely to be encountered in dwellings. It is exceedingly annoying, at times rendering it almost impossible to read or do anything else requiring close attention. It attacks the wrist, fingers, and ankles by preference, in the latter case thrusting the beak through stockings. It is very quick of movement, and very sly, disappearing completely when one makes a vigorous demonstration, hiding apparently on the under sides of tables and other furniture, and only reappearing when one becomes absorbed again in his work. Without reference to its capacity

to carry yellow fever, it is a pest of the first rank, and health departments in our cities can do no better work for the comfor and even health of those who employ them than by making a crusade against this insect. It undoubtedly drives many people out of the State each year during the summer months, and is a standing menace to the welfare of the State by rendering it less attractive to desirable settlers.

Like many another rascal, the mosquito itself bears an attractive exterior, being elegantly marked with brilliant silvery lines and dots, though these become apparent only by the use of a hand magnifier.

Stegomyia fasciata *(The Yellow Fever Mosquito).–General color dark brown, appearing black. Eyes deep velvety blackish brown, bordered behind by a silvery line, which joins a broader median line extending forward between the eyes, about to their centers. A couple of silvery white dots behind each eye, a pair of dots at the base of each antenna. Antennæ gray, slender and inconspicuous in the female, strongly feathery (plumose) in the male, Feelers (palpi) of female very short, with a white dot at bases and another at tips. Feelers (palpi) of male rather longer than the proboscis, black, with four white bands. Proboscis black. An angled silvery white line begins close to the middle line of the thorax above, extends outward and downward, gradually widening, and then inward and backward finally continuing in a nearly straight course as a very narrow line to the hind margin. Between the front extremities of these angulate lines begin two narrow pale yellowish lines at a small white median dot flanked with black, and extend backward in a parallel course well toward the hind edge of the thorax. Hind edge of thorax with a white edging composed of projecting scales (these only to be recognized with a microscope). About thirteen silvery-white dots in sides of thorax. Wings without markings. Legs black in general; front femora black in front, pale behind, a silvery dot at the tip of each; front tibiæ black, with pale yellow

*According to Dr. L. O. Howard this mosquito has recently been removed from the genus Culex by Theobald of the British Museum, and with a few other species placed in the genus Stegomyia.

spines; the two basal tarsal divisions white at base. Second pair of legs marked like the first, but the femora more extensively pale. Hind legs very long; the outer end of the femora black, with a white dot at tips; tibiæ black; first tarsal division white at base for 1-6 its length; second division white at base for 1-5 its length; third division white at base for 1-4 its length; fourth division white at base for 3-4 its length; fifth and last division white except a slight duskiness at the tip. Abdomen black, each division above with a basal white line and on each side with a rather large silvery dot, forming a lateral series along each side of the abdomen; central region of abdomen beneath chiefly silvery in fresh and unrubbed examples.

Length of female 1-5 inch, of male 1-6 inch, but the size varies a good deal in both sexes.

This mosquito is not a recent introduction, as has sometimes been suggested to me. Nor was it brought here by soldiers encamped in the State during the late Spanish war. I have been familiar with it since 1889, and there is no good reason to suppose that it was not here when the country was settled. That individuals are every year brought here from the far south in compartment cars and in the staterooms of steamboats is very probable. But the species has been a fixture here for at least ten years.

It is more than any other species known to me a house-infesting mosquito, being found in dwelllngs at all times during the summer, and probably hibernating there in winter. A recent cold spell at Lexington in October was the occasion for the disappearance of most of them, but on warming rooms during the coldest of the weather, individuals came from their hiding places and continued their attacks. They did not go to cellars at this time, for a special search was made for them there. Numerous individuals of the brown *Culex pungens* were found, but none of this species. It did not resort to caves. *C. pungens* and *Anopheles punctipennis* were both found there, but no yellow fever mosquitoes. During this same cold spell young of small size were found in rain water left in the bottom of a barrel, and some of these have as late as October 26

yielded adults. It is possible from this circumstance that the species may pass the winter as a wriggler.

The species is found in warm regions throughout the world. Contrary to the rule among mosquitoes, the male is said to bite. I have never succeeded in observing this.

Breeding Places of the Yellow Fever Mosquito.—I have not made a special search for the young in pond and ditch water, but about dwellings have found them very abundant in barrels, buckets, or any other vessel that may for any time retain water during the summer. Many of our citizens thus unawares grow their own mosquitoes, though it often happens that one man allows enough to mature on his place to supply a neighborhood. It is a very common practice to leave buckets and other utensils in the yard, half filled with water, to save them from drying out, and in these I have often found the young by the thousands, with numerous masses of eggs floating on the surface.

Danger of Yellow Fever in Kentucky.—The abundance of this mosquito is not ground for any alarm on the score of yellow fever except when the fever is so prevalent at the South as to increase the chances for contaminated individuals being brought here by boat or rail, or in the case of the coming into a neighborhood of people suffering from the disease. *The insect does not carry in its body at all times the germ of the disease. It must first sting a yellow fever patient, then, after the lapse of about two weeks, its bite is not less deadly than that of a rattlesnake.* That the disease may become established here is shown by the outbreak in 1878 at Hickman, in western Kentucky. In Mr. John R. Proctor's excellent account of this instance, printed in a bulletin of the Kentucky Geological Survey in 1879, it is stated that the disease began in August, the month of all others when the mosquito is most abundant and active; that a total of 749 cases of yellow fever occurred, resulting in 149 deaths.* Probably a search of old records

*A very striking difference between the death rates of whites and blacks is recorded by Mr. Proctor, the percentage being 50 per. cent. among the former and only 9 per cent. among the blacks. The age of those attacked ranged from 6 to 68 years.

would show that the disease has been here at other times.

Treatment—This mosquito is more completely under our control than that conveying malaria, because of the nature of its breeding places. By far the greater number emerge from rain barrels, tubs and the like, that could, if we were driven to it, be dispensed with. If health officers would educate our people to the importance of getting rid of such breeding places Kentucky would be a pleasanter place to live in during the hot summer months.

In case of an outbreak of yellow fever, the removal of all breeding places of this sort should be made compulsory, with the alternative of making a liberal use of coal oil on the water.

The ponds often left about our cities should be drained or filled.

When no precautions of this sort are taken by the authorities, each must look out for himself, and many a person will be surprised when he has tried it at the relief he gets from the plague by simply clearing his own premises of breeding places. Screens in doors and windows are often not effective for the reason that this is a day-flying insect, that gathers on screen doors, ready to swing into the house whenever the door is opened. An imperfect screen or a defective one is useless against it, since it is expert in searching out any opening through which it can pass. From the small size of its body, coarse mosquito bar, with a mesh that will exclude Anopheles, is no protection.

The bruised leaves of the castor oil plant answer no useful purpose as a protection.

Naphthaline rubbed on hands and face when going to bed affords some protection.

Coal oil answers a similar purpose.

Oil of pennyroyal is reported good, but I cannot speak of it from experience.

Insect powder placed in a metal tray and held over a hot flame for some time, gives off fumes that stupefy and kill the mosquitoes in a room, and has proved one of the most satisfactory procedures I have tried. It is possible by smudging a

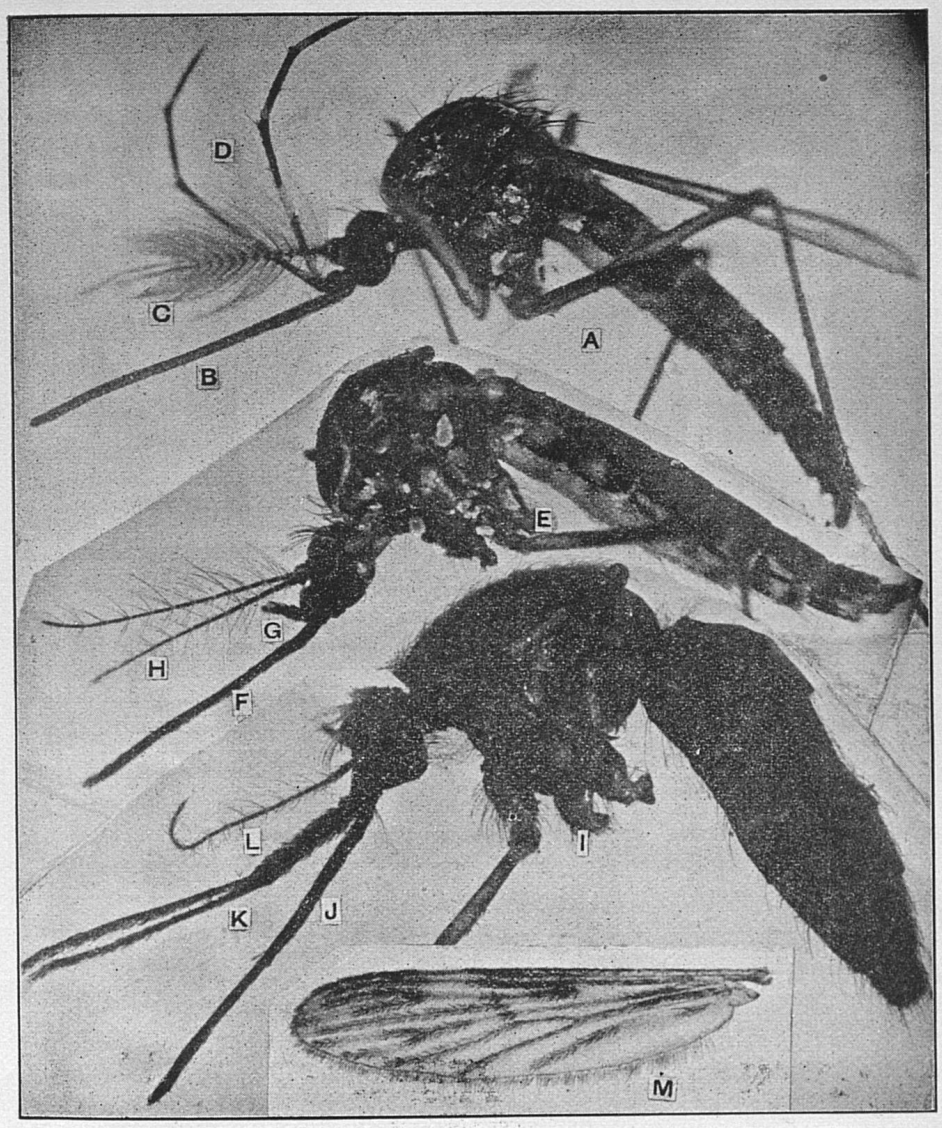

FIG. 1.—A, male of yellow fever mosquito; B, its proboscis; C, its antenna; D, its palpi. E, female of yellow fever mosquito; F, its proboscis; G, its palpi; H, its antennæ. I, *Anopheles punctipennis*, one of the malaria mosquitoes; J, its proboscis; K, its palpi; L, its antennæ. M, wing of *A. punctipennis*.

Photographed from the microscope. (Original.)

bedroom on going to bed to get sleep until daylight, at times when it would be impossible otherwise.

As intimated elsewhere, this is a diurnal mosquito, though it will continue active during very bright moonlight nights. Though the insect may be abundant in a house, its attacks can be avoided at night, in great part, provided one can exclude all light from sleeping apartments.

OTHER KENTUCKY MOSQUITOES.

Several other mosquitoes occur in the State, but as far as known are not as important as those mentioned as carrying disease.

Culex pungens.—Of these, a reddish brown species becomes common in cellars, caves, and to a less extent in the living rooms of dwellings, after cold weather sets in in the fall. I have never seen an engorged example, and have never observed it feeding.

Culex impiger.—This is a small obscurely colored species collected by me in the woods along Kentucky River. It has not been observed in dwellings.

Psorophora ciliata.—This is our largest mosquito, the body measuring nearly ½ inch in some examples. It is of an obscure brown color, without decided markings. The wings are slightly smoky. A single example was taken by me June 23, 1893, at Brooklyn Bridge, Jessamine county. I have encountered the same species in other states, always in the vicinity of rather large streams or lakes.

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3. Poisonous and Edible Mushrooms.

BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

Following a drought during August of last summer copious showers of warm rain had the effect of inducing an unusual growth of exceptionally fine mushrooms in Kentucky, and en-

ticed by their attractive appearance, people were in some instances led to extend their acquaintance with this kind of food with unpleasant consequences. At Lexington, among the victims of this incaution were numbered the *Chef* of our leading hotel and a Chief of Police. Fortunately no one lost his life, but the lesson learned by those who were made sick has not, we may be sure, from past experience, been learned by everybody, and it is with a desire to enforce the lesson while it is still fresh in our minds that a few words are added on the subject of edible and poisonous mushrooms, and some figures are presented that show the characters by which the commonest poisonous species (the one responsible for the cases of poisoning last summer) may be recognized.

One often encounters the names "mushrooms" and "toadstools" used in such a way as to imply that there are two groups of these fungi, one of which may be eaten without ill effect, the other containing only poisoning species. There is nothing in the idea worth considering for a minute were it not for the fact that it sometimes leads people into trouble. Both poisonous and non-poisonous species are "mushrooms" or "toadstools," whichever one pleases to call them. Both edible and poisonous species, closely allied in all structural characters, belong in one and the same botanical genus, though in some case the majority are poisonous in one such group, while most are edible in another. Characters by which toadstools may invariably be distinguished from mushrooms cannot be given. They do not exist in nature. And herein lies the danger to one who has but a slender knowledge of such things. Botanists have long known this, and have repeatedly urged caution on those who in every community are disposed to set themselves up as oracles on the subject. Writing in 1848, the botanist Lindley said of Professor L. C. Richard, "although no one was better acquainted with the distinctions of Fungi, he would never eat any except such as had been raised in gardens, in mushroom beds." This appears the extreme of caution, yet there is better ground for it than any one man's experience is likely to indicate. I am not disposed to go this length myself, and would suggest that when one is

thoroughly acquainted with the common edible mushroom known in the books as *Agaricus campester* he may eat it freely, having only himself to blame for ill consequences in case he gets it in very hot moist weather after it becomes tainted. All of these soft fungi decay with extreme rapidity under such circumstances, possibly at times developing something in the nature of ptomaines; for cases are on record of sickness resulting from eating some of the best known edible species.

In case one desires to test others, it is the part of wisdom to submit specimens to a botanist for determination first, and if this is not practicable, then the discovery, which Lindley says was made by Paulet in 1776, that soaking poisonous species in salt and vinegar renders them harmless by dissolving out the poison, may be brought into use. Quite recently I was told by an American botanist, quite capable of determining mushrooms for himself, that he would not eat any species without first subjecting it to this treatment.

Those who wish to compare mushrooms with published descriptions should familiarize themselves with the followlng terms:

1. *Stipe*, *stalk*, or *stem*.—Synonyms which when placed together are readily understood.

2. *Pileus* or *cap*.—The expanded upper portion of a mushroom, more or less closely resembling the top of an umbrella, the stem representing the handle.

3. *Lamellæ*, or *gills*.—The soft, plate-like structures on the under side of the cap, sometimes terminating at or near the stem, sometimes running down on the upper part of the stem, in which case they are styled decurrent.

4. *Spores*.—Microscopic fruit of the mushroom, developing on the surfaces of the gills. Their presence can be best determined by examining a bit of a gill under a compound microscope. To determine their color, remove the cap from the stem, and place it, gills down, on a sheet of paper over night. The spores will be shed in large numbers, and then constitute a white, yellow, brown, pink, etc., dusty coating on the paper.

5. *Ring*.—A ring-like structure on the upper part of the

stem near the cap, sometimes small and closely joined to the stem, again large and more or less free.

6. *Volva.*—A wrapper-like or sheath-like envelope about the base of the stem, more or less loose and open at its upper end. Remnants of the same structure are sometimes left on the cap.

7. *Mycelium.*—The matted growth of fine threads in soil or wood from which the mushroom arises.

KINDS OF MUSHROOMS EATEN.

The species commonly eaten in this country belong to the three botanical orders, as follows:

The Morels (*Discomycetes.*) With a stem and a conical or oval cap the surface of which is scooped out into numerous hollows separated by ridges. A common edible species is known as *Morchella esculenta*, and is found in damp places on the ground in woods and thickets.

The Puff-balls (*Gasteromycetes.*) — More or less globular species, often of large size. The species commonly observed in blue-grass pastures is somewhat constricted next the ground, giving it the appearance of having a very thick stem. It is one of the best edible species, to my taste.

Toadstools and Coral Mushrooms (*Hymenomycetes.*)—Frequently umbrella-shaped, sometimes branched; wood-infesting species sometimes attached by one side. The following families contain edible species, part of them also poisonous species:

1. *Clavariei.*—Branched or lobed mushrooms resembling in some cases the bleached skeletons of corals and hence called coral mushrooms.
2. *Hydnei.*—More or less umbrella-shaped species, with numerous tooth-like processes on under side of cap.
3. *Polyporei.*—Frequently umbrella-shaped, often attached by one side to stumps; the under side of cap with small pores, opening into tubes in which the spores develop. Some are edible, others poisonous.
4. *Agaricini.* — Umbrella-shaped or attached by one side, with plate-like gills on under side of cap. Contains the common edible mushroom, and also the

commonest and most dangerous poisonous species. They are sometimes styled The Agarics, and to the French, several edible species are known under the name Champignon.

A COMMON POISONOUS MUSHROOM IN KENTUCKY.

Lepiota morgani.—The species to which the cases of poisoning at Lexington were traced, is a member of the family Agaricini, being decidedly umbrella-shaped, with a thick central stem and a large cap, often reaching a diameter of seven inches, and sometimes even surpassing this. It is mainly white, and in late August and early September this year could be detected long distances dotting the blue-grass pastures, as one rode along the pikes.

The cap is a spherical or slightly oval ball as it first appears above ground, and as it grows breaks away beneath from about the stem, leaving a large ragged ring about the latter, and assumes the form which I have styled umbrella-shaped. The upper surface of the cap is at first strongly convex, somewhat brownish, and is roughened by brown scales formed by a breaking of the cuticle. At the center is generally a region rather more convex than the rest, and this apex is often unbroken and uniform brown. When fully expanded, the cap is but little convex. The gills beneath are pure white at first, wide, close-placed, some of them imperfect ; all of them terminating before reaching the stem, so as to leave a vacant space about the latter. As the gills grow older they become greenish, and finally acquire a decided green color, due to the maturing of the spores, in which the green coloring matter is lodged. An example collected at Lexington in September measured 5½ inches in diameter of cap, the fleshy part where thickest about equaling the depth of the gills. Stem 7 inches long, with a swollen base, but no volva, 1 inch in diameter. Ring moveable, 1¼ inch in diameter. The stem separates readily from the cap as if its upper end were in a sort of a socket ; it is smooth, but in some examples shows indications of scales at the base. The whole plant becomes brown and dries up as it stands, during dry weather.

This mushroom is the more dangerous because of its attractive appearance when fresh, and its close general resemblance to the edible species most commonly brought to our tables. Its green spores will distinguish it readily enough. It is only necessary to remove the cap from the stem, place it, gills down, on a sheet of white paper, and if a green powder is left the next morning the chances are that it is this species. I do not know any other species which leaves this green color behind. Generally a faint green tinge can be detected about the gills in any large example, and this of itself is to be regarded as ground for rejecting a specimen. Its large size will also serve to distinguish it from the common mushroom, as well as the scales in the upper side of the cap, and its large loose ring.

It is not to be regarded with as much dread as mushrooms of the genus Amanita, some of which have caused the death of those who ate them. One who has been so incautious as to eat this Lepiota can usually count on a severe digestive derangement, but if the experience here at Lexington is a safe ground for judgment, may relieve himself of the fear that the attack will prove fatal. It happened in some cases that only part of those who ate them at the same table were affected. In one case known to me, they were eaten by a family without any ill effect. From some inquiry concerning the local cases of poisoning I am disposed to think that the poison, whatever it may be, develops when the fungus is somewhat old. One of the cases resulted from eating half of a very large mushroom. In another case, I am told that the green dusty coating, composed of the shed spores, was observed beneath some specimens that were left from those that had been cooked.

OTHER POISONOUS MUSHROOMS.

The species dealt with above has no sheath or volva at the base of its stem. But in several genera belonging to the same family, all umbrella-shaped, are species, sometimes brightly colored, sometimes not, that are regarded as the most dangerous of all mushrooms, and most of them have a well-developed volva. They are described in the books under the genera Amanita, Volvaria, etc. While some species reputed edible

belong in these genera with the basal sheath, no one who has not a good botanical knowledge of mushrooms should venture to eat any of them even after looking them up in the books. As already intimated these mushrooms cannot always be recognized by their brilliant colors, for some of them are dull. Most of them can be recognized by the volva, but even this structure fails us in the case of one of the best known poisonous species (*Amanita muscaria*), in which only scales are left finally in place of the sheath. Generally members of the genus Amanita have a warty cap, but rains may remove these loose remnants so as to leave a smooth surface. A ring is present about the upper part of the stem, but in at least one species this is closely attached and obscure.

Most of the deaths which have resulted from eating mushrooms are chargeable to members of this genus Amanita. For most people the edible species of a closely related genus, Amanitopsis, may as well be avoided also. It differs from Amanita mainly in lacking a ring about the stem, but the species have a warty cap, and a well-developed sheath (volva).

THE COMMON EDIBLE MUSHROOM.

Agaricus campester.—At the time the poisonous mushroom was most abundant last August and September, the best known edible species was also exceptionally common in certain fields. From one of these, large quantities were gathered by Lexington families. Fortunately this excellent mushroom was not generally associated with poisonous species, and in fact the edible mushrooms appeared generally to frequent ground not occupied by mushrooms of any other species. This was probably the result of such places having been previously heavily fertilized with stable manure, thus furnishing the condition specially favorably to this champignon. A description drawn from mushrooms gathered at the time follows:

White, with pink gills, which later become brown, finally deep brown, or almost sooty black, as examples dry out. Gills close placed, free from the stem. Spores roundish-elliptical, purplish brown. Cap smooth, convex at first, finally nearly flat, its edge disposed to turn inward so that it is visible beneath. 2½ inches or a trifle more in diameter. Stem smooth,

stout, rather short, frequently noticeably contracted at the base; in the larger examples about 1½ inch long; not hollow, but the center with loose tissue. Ring small, often nearly or quite wanting. No volva. In young, the cap forms a knob or ball at the free end of the stem.

While the above description fits the mushrooms observed about Lexington this season, it is to be remembered that more than a half dozen varieties of this species have been described in this and other countries. The cap may reach a diameter of 5 inches, but appears never to reach the size of that of the poisonous Lepiota. Its color may be gray, or brown, in one variety the surface with small rust-brown scales. The gills are white in one variety when they are young. The stem is sometimes even in diameter, sometimes bulbous at the base; it may be solid or hollow. The ring may be large and persistent, or small and fugitive. In short, there seems to be no one character that is constant, and the statement, which I have recently seen in print, that it is a simple matter to distinguish this and other edible species from poisonous ones, is misleading, to say the least that can in courtesy be said of it.

None of its varieties has a volva. So far as I have seen them, all have *pink gills when young, and brown or black gills when older.* Their general shape once known is a guide, but there are many species so closely like them that one cannot depend on this alone. They do not grow on wood. The odor given off is not unpleasant, the taste of the raw "flesh" not disagreeable. *The spores are always brown.*

This is the mushroom commonly eaten at restaurants and hotels, and the young with knob-shaped caps are everywhere sold by grocers, put up in jars. It is the species most commonly grown for market.

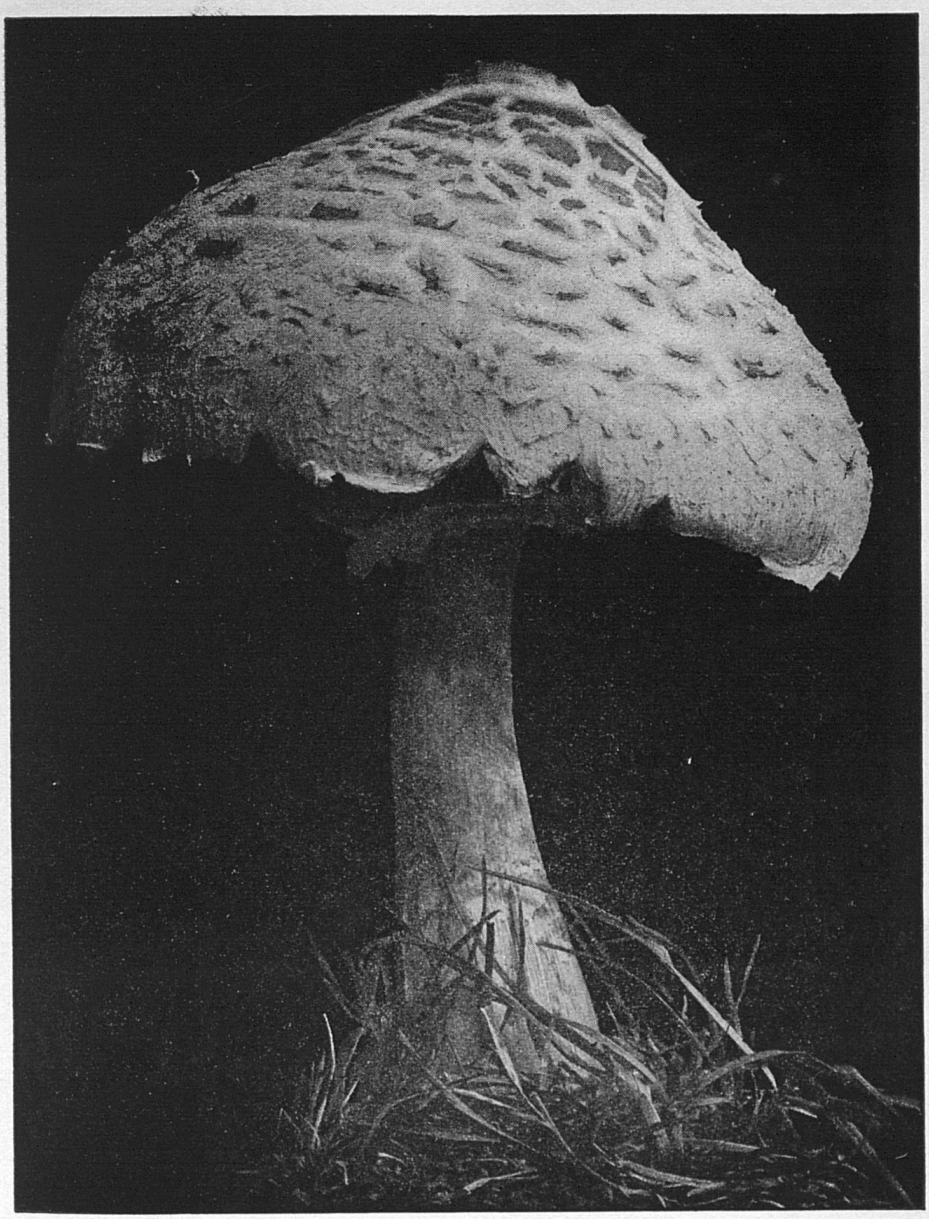

FIG. 2.— *Lepiota morgani.* Reduced to about two-thirds nat. size. Blue-grass pastures. Common. Poisonous. (Original)

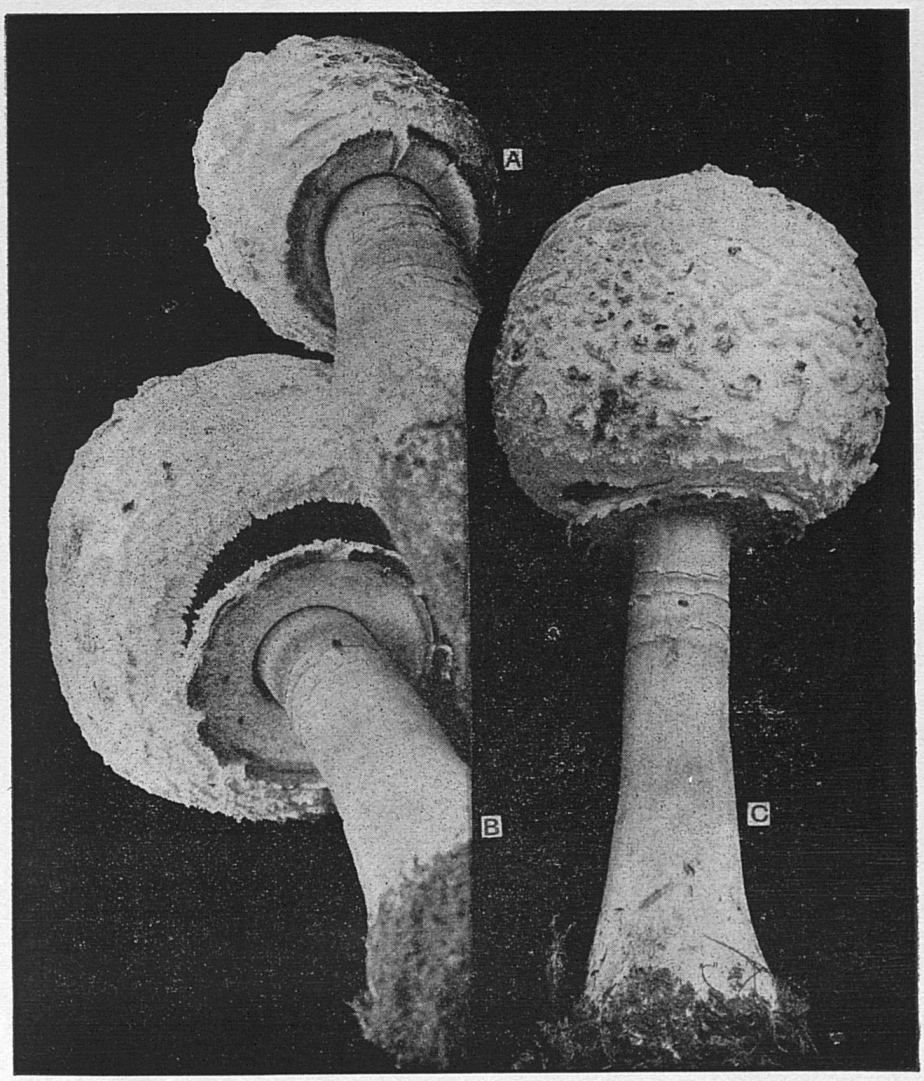

FIG. 3.—*Lepiota morgani.* A & B, nat. size; C, slightly reduced. Young examples. Blue-grass pastures. Common. Poisonous. (Original)

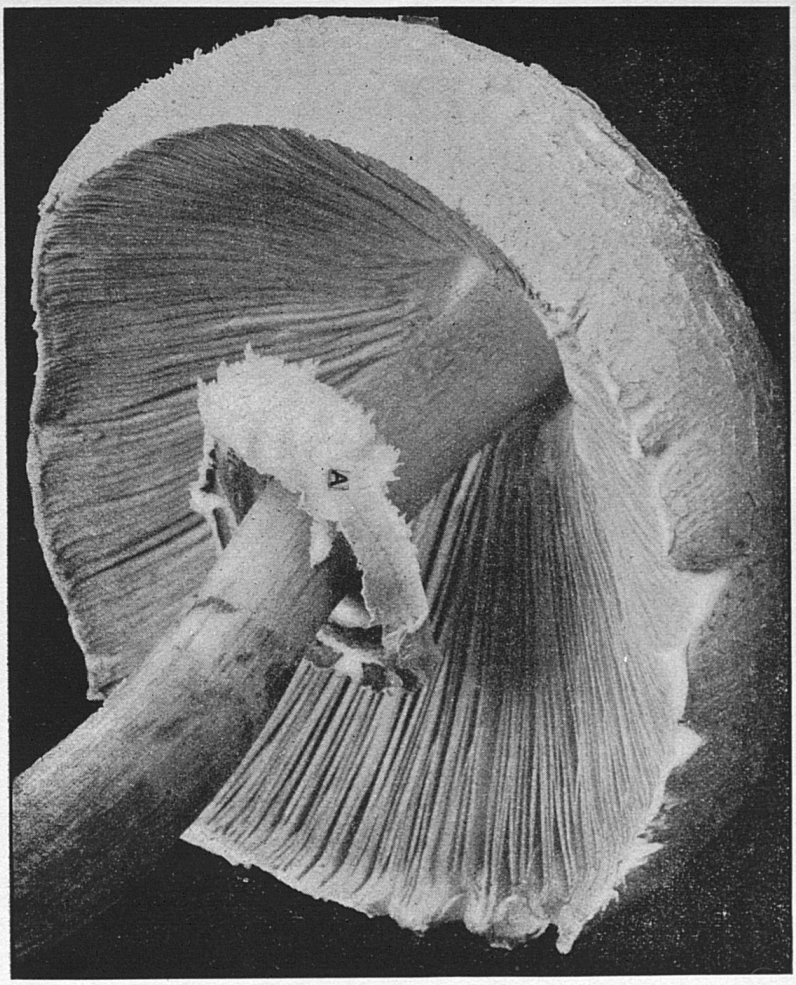

FIG. 4.—*Lepiota morgani.* Showing the ring at A. Nat. size. Blue-grass pastures. Common. Poisonous. (Original.)

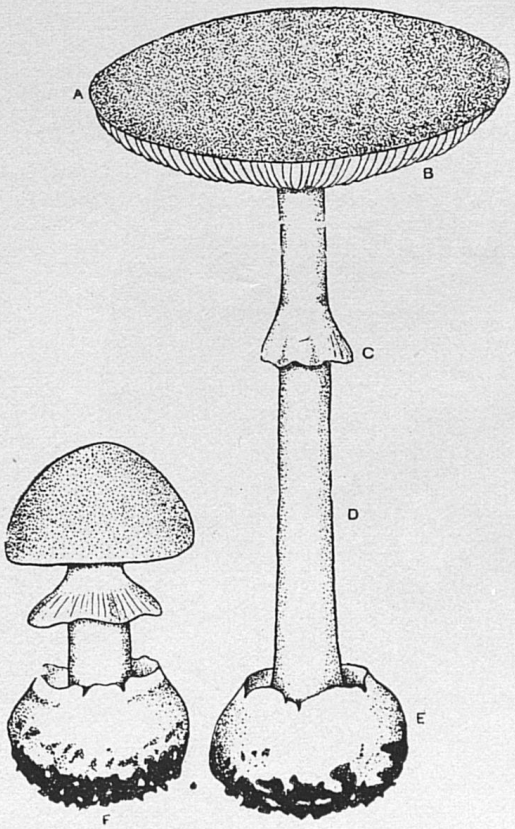

FIG. 5.—*Amanita phalloides*. A, cap; B, gills; C, ring; D, stem; E, volva; F, a young plant. Very poisonous. (After Peck.)

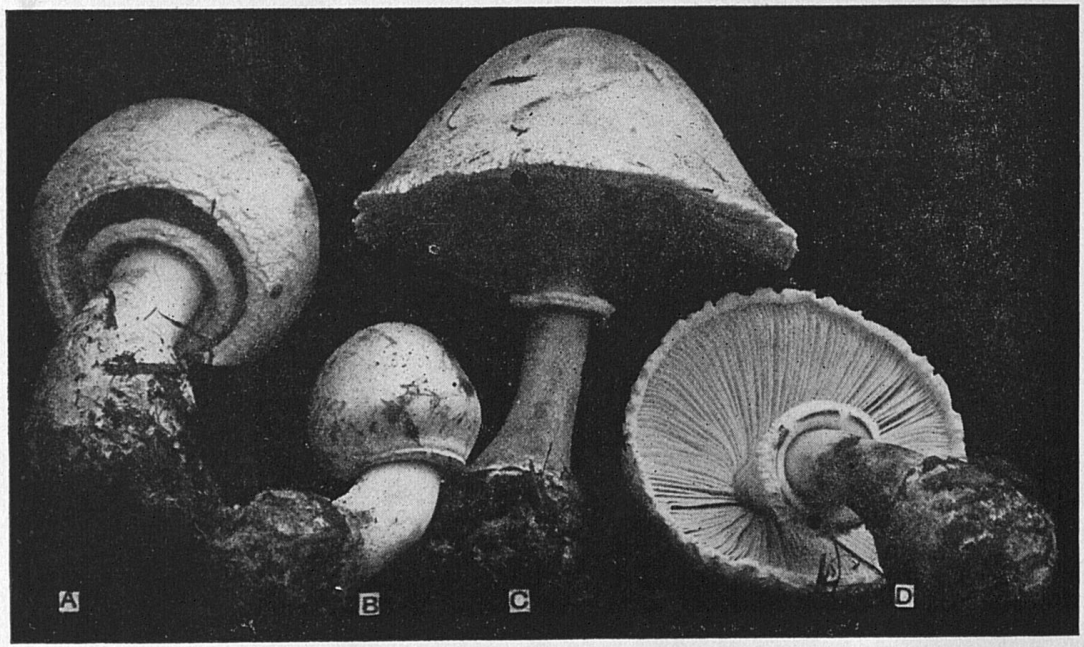

FIG. 6.—*Lepiota naucinoides*. Nat. size. Blue-grass sod in the Fall. Edible. (Original.)

FIG. 7.—*Lepiota americana.* Nat. size. Blue-grass pastures, on stumps. Edible. (Original.)

FIG. 8.—*Psathyrella disseminata.* Nat. size. Blue-grass pastures. Common about stumps. Edible. (Original.)

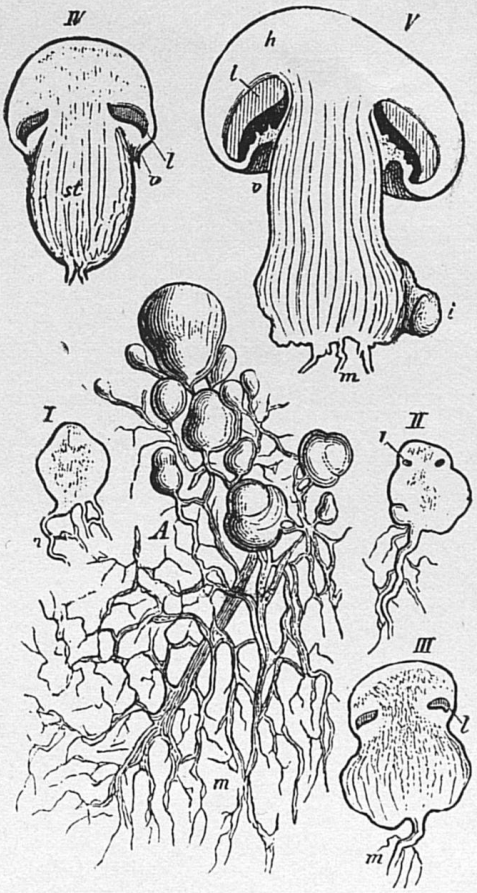

FIG. 9.—*Agaricus campester* at different stages of growth. *h*, cap; *l*, gills; *v*, veil stretching across from stem to cap beneath gills; *m*, mycelium. (After Goebel.)

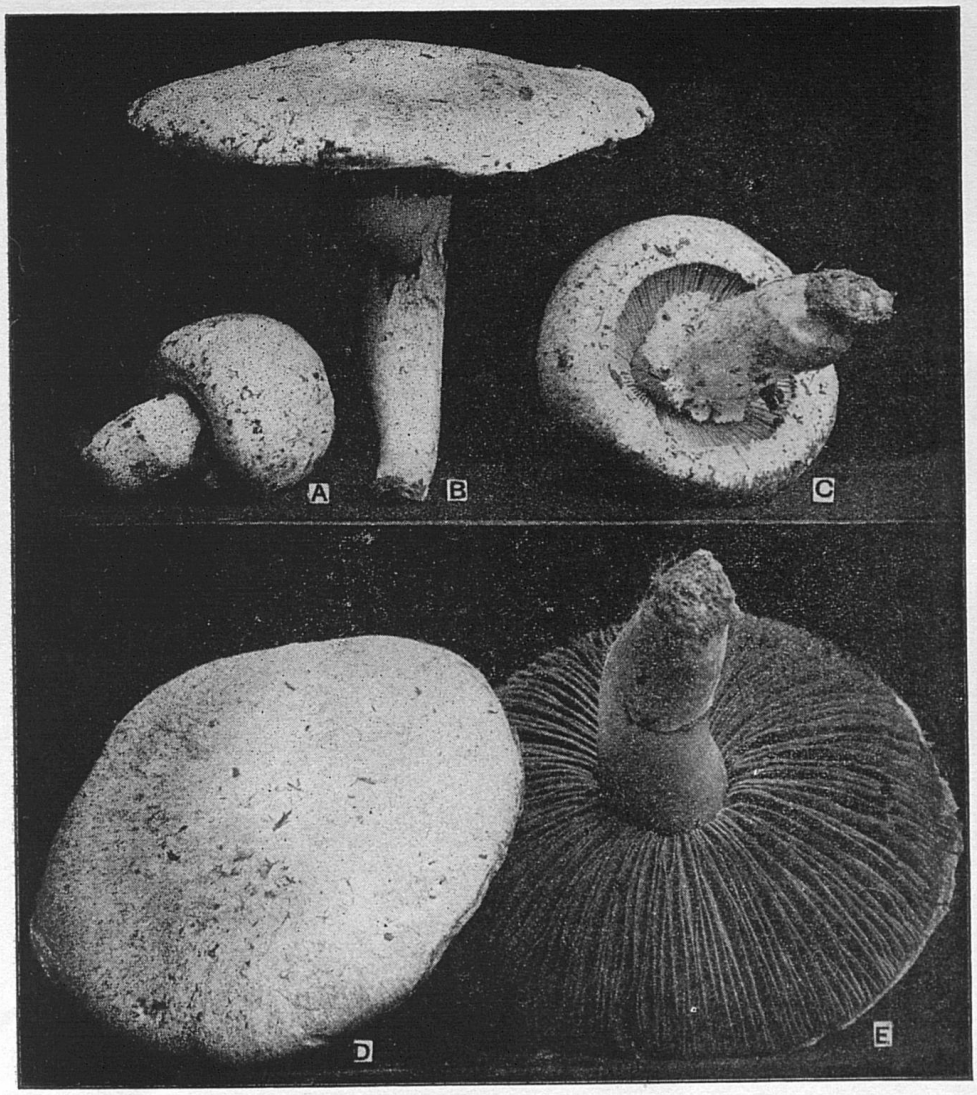

FIG. 10.—*Agaricus compester*. Nat. size. Open blue-grass pastures. The common edible mushroom. (Original.)

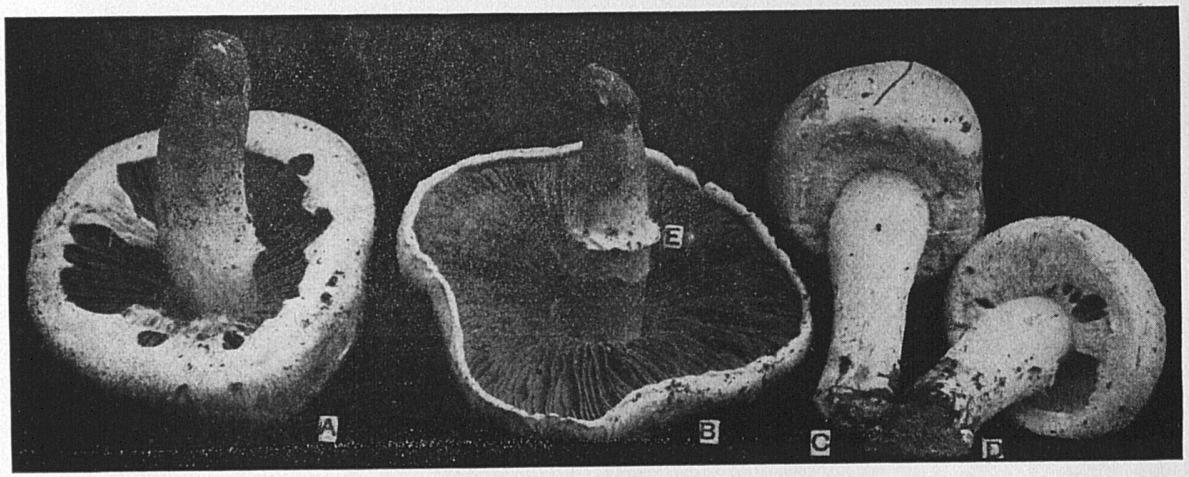

FIG. 11.—*Agaricus campester.* Nat. size. Open blue-grass pastures. The common edible mushroom. (Original.)

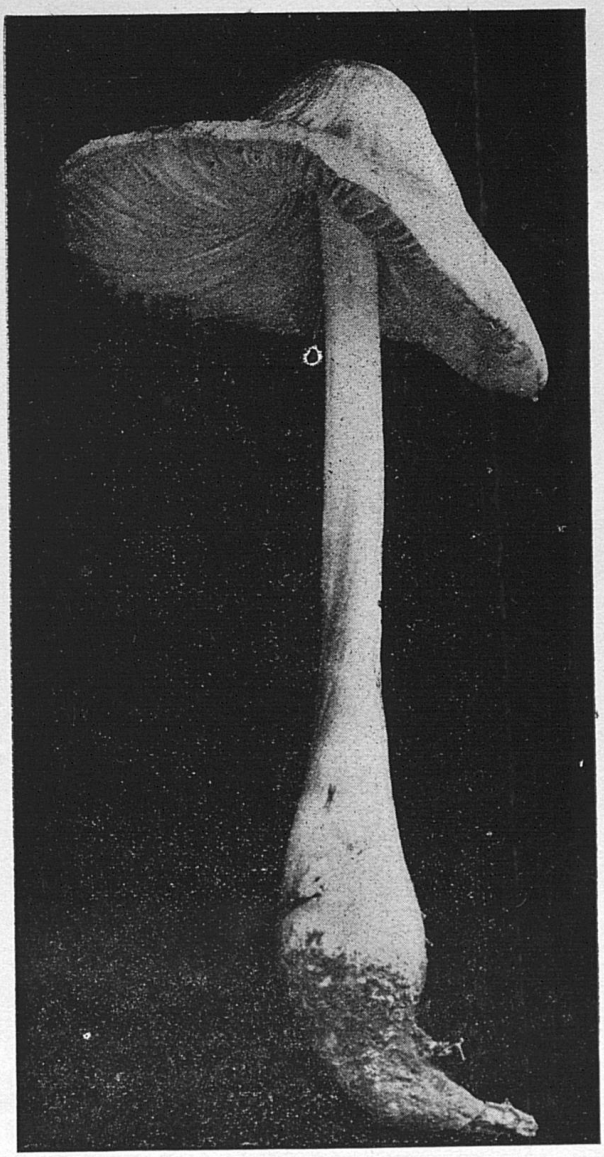

FIG. 12.—*Collybia radicata*. Nat. size. Showing twisted stem and long rooting base. Blue-grass pastures. Common. Edible. (Original.)

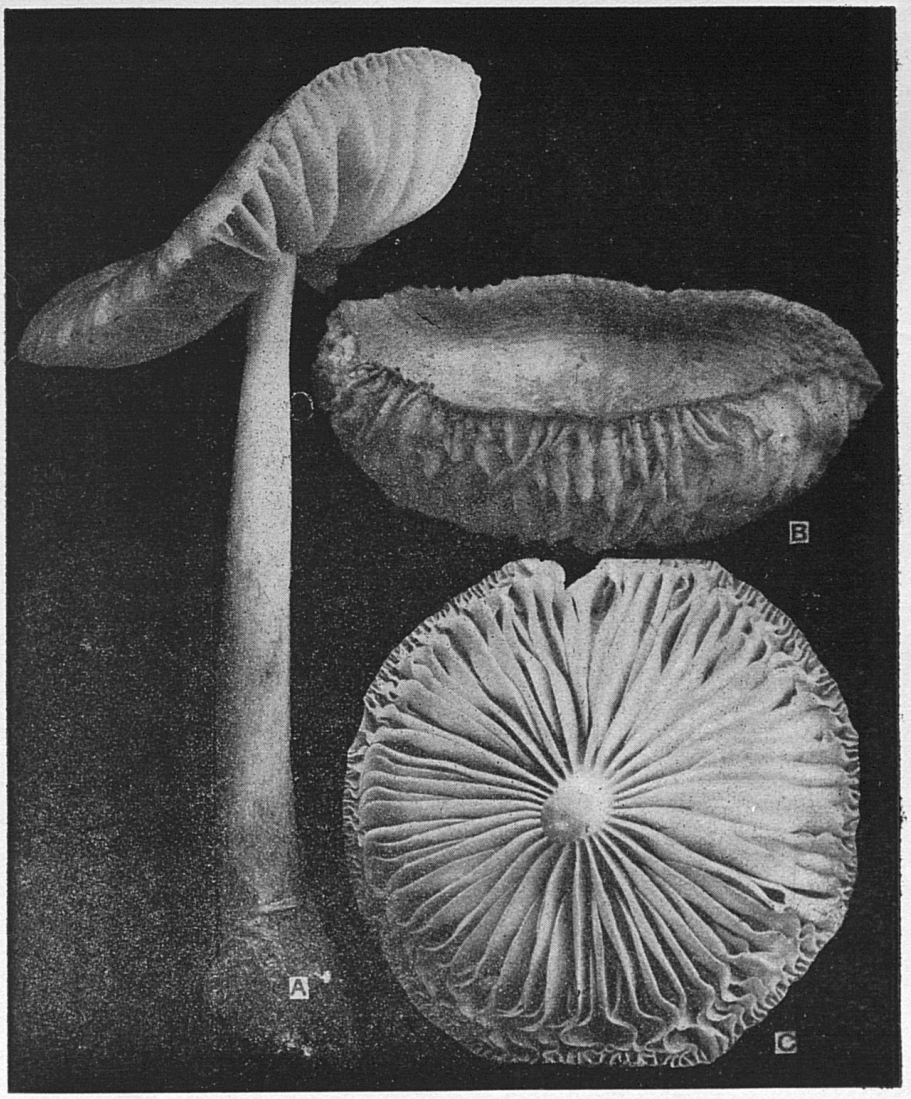

FIG. 13.—*Collybia radicata*. Nat. size. A, showing the graceful tilt of the cap, giving it a resemblance to a lady's hat; B, an old example, showing the surface of the cap concave and the gills drawn upward and inward; C, the gills seen from beneath. Blue-grass pastures. Common. Edible. (Original.)

FIG. 14.—*Hypholoma incertum*. Nat. size. Blue-grass lawns. Common. Edible. (Original)

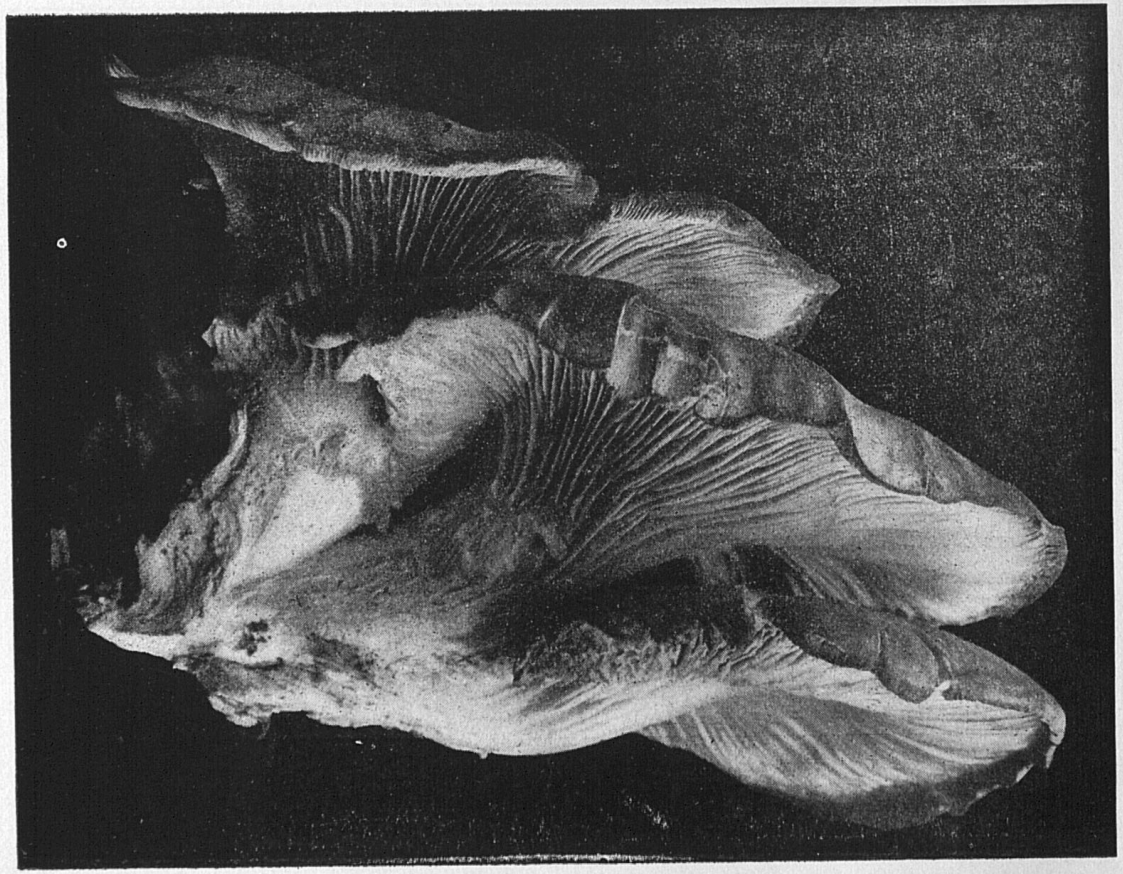

FIG. 15.—*Pleurotus ostreatus*. Nat. size. Blue-grass pastures on old logs and stumps. Common. Edible. (Original.)

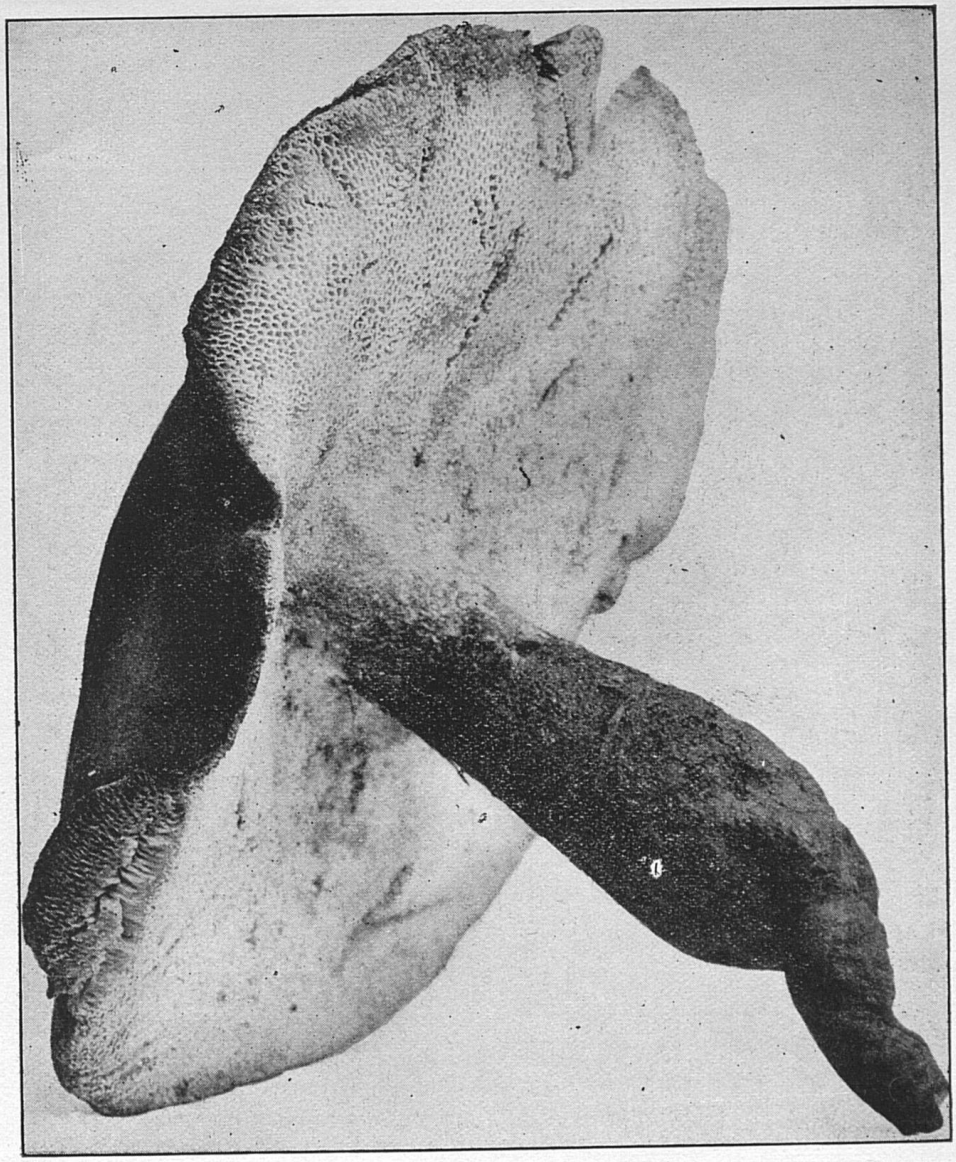

FIG. 16.—*Polyporus radicatus.* Nat. size. Woodland pastures, about stumps. Not tested for edibility. (Original.)

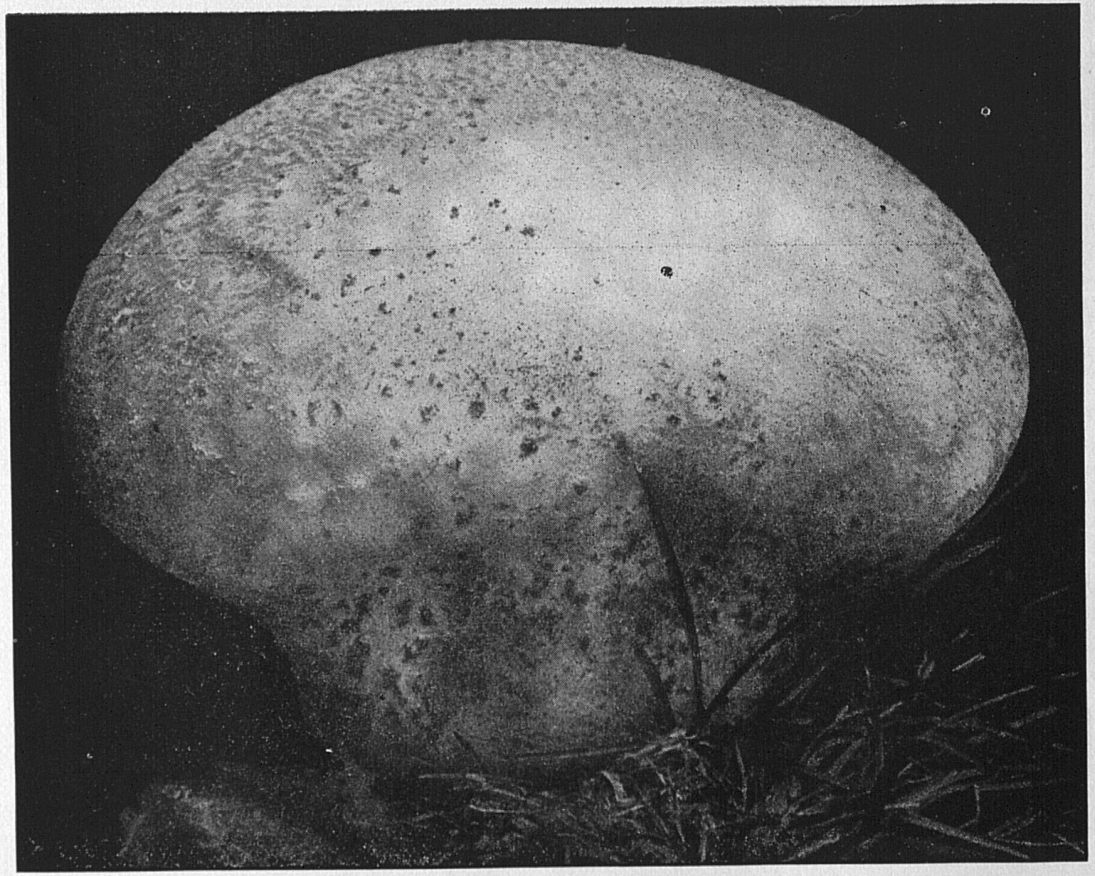

FIG. 17.—*Lycoperdon cyathiforme.* Nat. size. Blue-grass pastures. Common. Edible. (Original.)