OTT (Isaac)

Poisonous Mushrooms.

ART. II.—POISONOUS MUSHROOMS.

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The eating of mushrooms is a very common practice in France, Austria and Russia, and the deaths therefrom are correspondingly frequent. In these countries they are used by the poor like potatoes are in other countries. In the United States mushrooms are used in the preparation of sauces, and poisoning cases are not so very frequent; but lately, near Newark, N. J., there have occurred a few deaths from this cause. The agaricus comprises nearly one thousand varieties, the majority of which are poisonous. The Agaricus campestris is the edible variety most frequently used. The following are stated to be poisonous: A. muscarius, A. phalloides, a very common and very poisonous variety; A. balbanus, A. rubescens, A. pantherinus, A. virosus, A. solitarius, A. excelsus, A. torminosus, A. fuliginosus, A. crysorrhoeus, A. theogallus, A. necator, and A. rufus. In some encyclopedias, the advice is given that if they are sliced, soaked in vinegar for an hour, and then washed with boiling water they will be innocuous; but, as I shall show, these re-agents will not destroy the active principle in some species, and such guidance is dangerous and should be corrected. It must also not be forgotten that the edible variety under certain unknown conditions may become poisonous. Considering the slight differences between poisonous and edible mushrooms, it is not surprising that men well versed in this lore have made mistakes, which are usually dangerous or fatal. In fact the best advice for the majority of people is to let them alone, as none are very nutritious and all are hard to digest. In some species of agaricus, Letellier found a peculiar substance which he called amanitine. It is a nitrogenous body, soluble in water, but not in alcohol or ether; unites with acids

to form crystallizable salts. Apoiger discovered in them a volatile base, soluble in ether and precipitated by gallic acid, which is crystallizable, has a smell like that of conium, but did not kill rabbits. He also found a crystallizable acid which is volatile and poisonous to rabbits, and an ethereal oil with a mushroom smell. When poisonous mushrooms are eaten, the symptoms are slow to develop, very seldom in half an hour, but usually in six to twenty hours. They are, colic-like pains in abdomen, choking, vomiting, great thirst without any considerable fever, diarrhœa, general coldness, great anxiety, great weakness, pale countenance, pulse unable to be felt, sometimes tetanus with frothing at the mouth; finally cramps, convulsions, general stupor, unconsciousness with great distension of the stomach, and death. In some cases there is dizziness, colored vision, narrowing of the pupil, flow of saliva, inflammation of the tongue, pain in the throat, dyspnœa, strangury and so on. The diagnosis of deaths from this cause is made by an examination of the intestinal contents, which under the microscope would present the sporules, aided by the fluid character of the blood, and the great abdominal distension. In the fall of 1868, in the vicinity of the University of Dorpat, Prof. Schmiedeberg* collected some Agaricus muscarius, and by chemical treatment obtained an alkaloid which he called muscarine; this body is only comparable to nicotine, is odorless, colorless and tasteless, strongly alkaline syrup-like, consistence, soluble in water and absolute alcohol and insoluble in ether.. By standing over sulphuric acid it gradually becomes crystalline. By heating, the dry crystalline mass becomes fluid and about 80° Cent. begins to brown, and when heated over 100 C. (212° F.) it is still solid, but by a higher heat it melts with the generation of a weak tobacco-like odor, and is consumed without any disposition to sublime.

Schmiedeberg† has since shown that muscarine is isomeric with betaine. In the A. muscarius, he has also found a second base not poisonous, isomeric, and corresponding with choline or hydroxaethylidentrimethylammoniumhydrate in all important peculiarities, and which by heating gives trymethylamine.

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*S. und Koppe. *Das Muscarine.* Leipzig, 1869.

† S. und Harnack. *Centralblatt*, 1875, No. 36.

This second base which he calls amanitine, by oxidation with nitric acid gives, not as choline, betaine, but muscarine.

Amanitine must be looked upon as a hydroxaethylidentrimethylammoniumhydrate, that is

$$(N\begin{cases}(CH\ )3\\ CHOH\text{-}CH_3)\\ CH\end{cases}$$

and muscarine as

$$N\begin{cases}(CH_3)3\\ CHOH\text{-}CHO\\ CH\end{cases}$$

He also obtained from egg-albumen by chemical treatment, muscarine which did not differ from that obtained from the mushroom.

On cats, Schmiedeberg found muscarine in subcutaneous doses of a milligramme of the sulphate to cause, in a few minutes, chewing or licking movements, profuse flow of saliva, increased secretion of tears, colic, vomiting, increased intestinal peristalsis, purging which is often bloody, with tenesmus-like pain, increased flow of saliva, which depends on peripheral stimulation of the chorda tympani; the narrowing of the pupil is one of the most constant symptoms. All these phenomena can take place before the movements are interfered with; the pulse sinks from the beginning; the breathing is very frequent and dyspnœic, the animal is sensitive to touch, and has a tottering gait. Later the respiratory frequency sinks; the animal lies extended, respiratory movements become weaker, and death ensues, preceded often by slight convulsions. The same series of symptoms take place in the dog. In rabbits the pulse frequency and secretion of saliva occur as in cats, but the respirations are more interfered with. On frogs the symptoms are mainly confined to the heart causing its arrest. The cause of death is in the respiratory apparatus and the heart; although the former stops first, it is not definitely decided whether it is by a direct action on the centres of respiration or through the slowness of the heart. Disturbances in the nervous system are probably not direct but a result of want of cardiac activity. Schmiedeberg also found that atropine was an antidote even in the agony of impending death.

Having through the kindness of Prof. Schmiedeberg received some chloride of muscarine, I made some experiments with it on frogs to test the antidotal property of atropine; I was further pressed thereto by the recent cases of poisoning, and the remarks of a medical journal* thereon.

Experiment 1. Frog-sternum removed.

3.55	P. M.	Heart-beat, 36 per minute.
3.58	"	.0005 gr. muscarine subcutaneously.
4	"	Heart stopped in diastole, on pricking makes a contraction; the ventricle is distended with blood, bulbous.
4.3.	"	.001 gr. atropine subcutaneously.
4.5	"	It spontaneously began to beat 28 per minute.
4.9	"	Heart-beat, thirty-six per minute. It continued beating till next morning and animal had completely recovered from the paralysis induced by muscarine.

Experiment 2. Toad, sternum removed.

12.57	P. M.	Heart-beat, 44 per minute.
12.58	"	A little muscarine subcutaneously.
1	"	Heart-beat, six per minute.
1.12	"	Heart stopped in diastole.
1.40	"	A little atropine introduced.
1.47	"	Ventricle commences to beat of its own accord twenty-four per minute.
1.54	"	Muscarine subcutaneously, but it only slightly slows the heart.

As is seen, muscarine is able to stop the heart, and atropine is able in the most beautiful manner to start it. As is known, there is situated in the heart certain nerve masses, called ganglia, which are divided into two kinds, inhibitory and excito-motor. Comparing the heart to a steam-engine, the excito-motor represent the steam, and the cardiac muscle the driving-wheel, and the inhibitory ganglia the brakes. Now, muscarine puts on the brakes, the driving-wheels stop because the steam or excito-motor ganglia are not able to overcome the resistence of the brakes, or inhibitory ganglia. But in

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atropine there is a force which in doses of a milligramme, is able to remove the brakes, when the driving-wheels, that is the auricles and ventricle revolve under the force of the excito-motor ganglia. By this poison he was also able to ascertain that nicotine was unable to start a muscarinized heart because it acted on the handle of the brakes, and not on themselves. Both nicotine and atropine paralyze the pneumogastrics; hence he inferred that nicotine acted not like atropine on the inhibitory ganglia but on ganglia connecting them with the ends of the pneumogastric. The antidotal effects of atropine to muscarine have been confirmed by Prevost* of Geneva. Böhm† of Dorpat and Schiff of Florence.

My experiments show that atropine is a complete antidote to muscarine.

Atropine paralyzes the chorda tympani, muscarine excites it; atropine paralyzes the cardio-inhibitory apparatus, muscarine excites it; atropine dilates the pupil, muscarine contracts it; atropine causes decreased intestinal peristalsis, muscarine increases it; muscarine decreases or stops the urinary secretion, atropine restores it.

Krenchel‡ has also shown that it causes a cramp of the accommodation in the eye which reaches its maximum in 15-20 minutes and passes away in one to one and a half hours.

Muscarine acts like calabar bean in some respects. Like the latter it excites tetanus of the intestinal tract, it contracts the pupil and produces a cramp of the power of accomodation, it excites the cardio-inhibitory apparatus which excitation is removed by atropine, restored by calabar, but not by muscarine. The question arises, how is atropine an antidote? As is well known atropine affords great relief in opium-poisoning. Now in opium poisoning not only does the patient forget to breathe, but the want of respiratory action is the cause of death. Von Bezold and Bloebaum have proved that atropine is a great stimulant to the centres of respiration, and allows the heart to run much faster. Here the excitant action on the respiratory centres and the sending of more blood to them with cor-

* *Centralblatt*, 16, 1875.

† Die Herzgifte.

‡ *Centralblatt*, 16, 1875.

respondingly more oxygen, relieves them from the narcosis. But in muscarine-poisoning, it is probably restoration of the heart to activity, that mainly is the factor, although the excitant action of atropine on the respiratory centres is not an unimportant element. It is highly probable that atropine is of much value in other cases of poisoning, where the death takes place by arrest of the respiratory apparatus.

Now the query arises: Is muscarine the poisonous principle in all poisonous mushrooms? On man after the subcutaneous use of three to five milligrammes of muscarine, Koppe states that there ensues profuse salivation and rush of blood to the head; redness of the face; the brow is moist and vertigo ensues; with this is griping and colic, and large drops of perspiration stand out on the face. The disturbed vision in connection with the vertigo and the weariness of the head have a remote similarity to the action of alcohol. These poisonous effects on man have a great similarity to the symptoms of mushroom-poisoning.

Schiff thinks that there is another alkaloid, but the most that can be said is, that the probabilities are strong that there is only one alkaloid which causes these deaths. It is quite true that there may be some narcotic principle associated with it. The following *résumé* expresses our conclusions.

1. That at least, in one species, Agaricus muscarius, there is an alkaloid called muscarine; that A. muscarius also contains a base called amanitine, a non-poisonous body.

2. That muscarine is a highly poisonous agent and that it is probably the poisonous body in all mushrooms of a noxious nature, associated with another alkaloid.

3. That in mushroom-poisoning with the usual employment of emetics, stomach-pump, purgatives and gallic acid, atropine should be given subcutaneously, say $\frac{1}{100}$ of a grain, the dose to be repeated according to indications.

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Thomas S. Wood 1877