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RABIES

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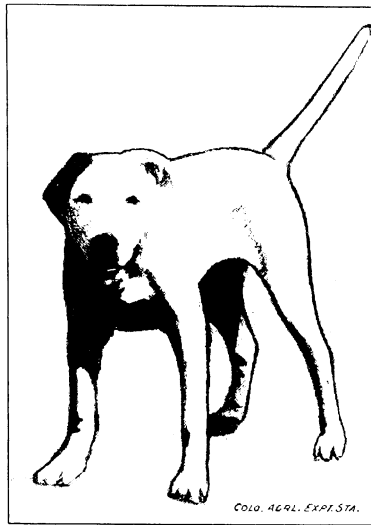


Fig 1.

FIG. 1.—A case of dumb rabies. Note the peculiar attitude and the dropped jaw. Reproduced from K. C. V. C. Bul.—Kinsley & Kaupp.



Fig. 2.

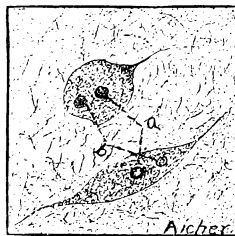


Fig. 3.

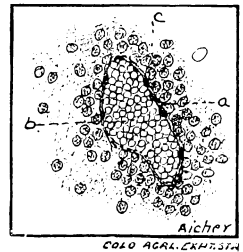


Fig. 4.

FIG. 2.—Section from plexiform ganglion showing degenerative changes; with round cell infiltration. Babes' corpuscles.

FIG. 3.—Nerve cells from Hippocampus showing granular condition of cytoplasm.

a.—Nuclei.

b.—Negri bodies.

FIG. 4.—Section from Medulla.

a.—Blood vessel wall.

b.—Red blood cells.

c.—Perivascular Infiltration.

# RABIES

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**DEFINITION:** Rabies is an acute infectious disease, usually transmitted by the bite of a rabid animal. It effects the cerebro-spinal system, and is accompanied by extreme nervous excitability.

## *History of Rabies in Other Countries.*

Rabies was recognized as a distinct disease by the Israelites and Egyptians as far back as 322 B. C. We find descriptions of it by Horace, Celsus, Virgil, and other writers of those times.

Rabies is most common in the north temperate zone, although it may be found in nearly every part of the world, and from the sea levels to the high altitudes. It is usually found most prevalent in the most densely populated districts, where the conditions are most favorable for its spread.

New Zealand, Tasmania and Australia are reported not to be infected with rabies. All animals, and especially dogs, are kept under strict quarantine for a period which is calculated to exclude the possibility of its introduction into these countries. St. Helena and the Azores are said never to have suffered from the disease. In many German cities, including Berlin, muzzling ordinances have done most to stamp out the disease. Through strict enforcement of the muzzling ordinances in England no case of rabies has been reported since 1901, and in Ireland since 1903. It is interesting to note that at one time rabies was so common in London that many people were afraid to venture on the streets at night. In France 1892 cases of rabies were reported during the year 1907, and in Belgium 226 cases with 179 suspected ones were reported the same year. During this same year 254 cases were reported in Austria, 55 in India (British), 1825 in Hungary, 701 in Italy and 36 in the Netherlands.

## *The Prevalence of Rabies in the United States.*

This disease was quite rare in this country till about 30 years ago. Since that time new centers of infection have been constantly appearing.

The presence of rabies has been positively proven in twenty-two states and probably exists in all.

In the District of Columbia, during 1907, rabies was identified in 37 dogs, 4 dingoes, 1 cow, 1 sheep and 1 cat. During 1905, from one pathological laboratory in Kansas City, 31 cases were reported as follows, 1 cat, 1 hog, 1 sheep, and the balance dogs. From this it will be seen that most cases occur in dogs.

## *History of Rabies in Colorado.*

The recent outbreak of rabies in Colorado is said to have started in Greeley about two years ago, when a dog which had just been brought to that place from the east, developed the disease. The in-

fectured area at this time seems to be confined to the eastern portion of Colorado and extends from about 50 to 75 miles north of Denver to as far south as Pueblo. The most thickly populated districts of this territory, as Denver and its vicinity, have the most cases.

The beginning of this investigation was on August 31, 1908, when a call came from Greeley, where several cases had been diagnosed as rabies among dogs, cattle, etc., In this investigation the disease was studied in one horse, two cattle, and eight dogs. This covered a period of less than six months. Laboratory findings were confirmed by repeated animal inoculations. Several people bitten by rabid dogs were advised to proceed to a Pasteur Institute and take anti-rabic treatment. The mayor and city council upon receipt of an official report that rabies existed in that city, enforced a muzzling ordinance. All dogs on the highways not muzzled were destroyed. The result of this procedure was that rabies was stamped out of Greeley.

Later a typical case was received from Loveland. In a few weeks two cases came from Longmont, and about ten months later a third case. This last, a dog, had bitten another and in thirty-five days the dog bitten developed rabies. One case has been received from Fort Lupton, one from Platteville, and three from Castle Rock. Two serious outbreaks of rabies, due to stray rabid dogs, have occurred within the past few months near Denver.

Since September, 1909, forty-three animals or their heads have been received at this laboratory from Denver. All but one head were from suspected cases of rabies. Of these heads two were from cattle, one cat, one wolf and the balance from dogs. Of these heads the brain of one was in a state of putrefaction and could not be examined and six did not show lesions of rabies. The balance, including two heads of cattle, showed lesions of rabies.

#### *Animals Affected.*

All animals may develop rabies when bitten by one that is rabid. This includes horses, cattle, sheep, hogs, dogs, cats, pole cats, mice, wolves, man, etc.

#### *Transmissibility.*

So far as has been proven the disease is only transmitted by the bite of a rabid animal or by inoculation.

#### *Virulency of the Saliva.*

The virus may be introduced into an already existing wound through holding an autopsy, or by the animal licking a wound. It is usually done by the bite of a rabid animal. By careful experiment it has been found that the saliva of a dog may contain the virus for seven or eight days before developing symptoms of the disease. As the virus is contained in the saliva, the teeth inflicting the wound carry the infection and deposit it in the wound.

It is a mistake to hasten to kill a suspected dog. The symptoms, if any, should be noted, and later, if rabies is diagnosed, the dog may be killed, and if desired, the head sent to the laboratory for microscopic examination.

*Persons or Animals Bitten.*

The wound should be cauterized at once, before the virus has had time to find its way beyond the point of reach of the cautery. This can best be done by the use of a red hot iron or by the use of dilute nitric or sulphuric acid applied deep into the wound with a stick, if nothing better is at hand. Nothing short of reaching the entire depth of the wound will be effective and this must be done at once. Lyssophobia, or fear of rabies, is common in nervous persons, who have been bitten by a dog rabid or normal. Should the dog biting a person be found free from rabies after keeping him confined for ten days, or a microscopic examination or by rabbit inoculation, the mind of the person should be set at ease. Should the dog be found to be rabid, the Pasteur Treatment, being a sure preventative when the person goes early, should also set the mind at rest.

*Period of Incubation.*

The period from the time the bite is inflicted until the symptoms of the disease appear, varies from three or four weeks to several months. It is doubtful if any authentic cases have developed after eighteen to twenty-four months.

The length of time that elapses from the bite until the animal develops the disease depends largely on two factors: first, the location of the wound, and second, the severity of the lacerations. The fact has long been established that the virus travels the course of the nerves. Thus if the wounds are in the facial regions the course from the inoculated point to the brain is short and the disease develops quicker. The deeper and more severe the lacerations, the greater the quantity of saliva introduced into the wound and the more dangerous it is. Thus in scratches the danger is not so great as when the tooth penetrates the flesh. Bleeding has a tendency to wash out some of the virus and lessen the danger.

In dogs, street rabies usually develops in from 23 to 35 days, in horses and cattle in from 4 to 6 weeks, in hogs and cats the time is about the same as in dogs. Street rabies is that form found from natural infection. The virus from one animal may be more or less virulent than from another.

The disease develops in pups quicker than in adult dogs, and in children in less time than in adults. In mature people the period of incubation is from 40 days to three months. While the mortality is considered to be 100 per cent., yet, conservative estimates place the number of those bitten that develop the disease at 16 to 20 per cent. Under certain conditions the percentage runs higher. The clothing or the thick coat of hair, in animals, has a tendency to clean the teeth of saliva and lessens the probability of infection.

*Dumb Rabies.*

The form known as dumb rabies may characterize the disease from the first or may develop in the later stages of the furious type. This form of disease runs a more rapid course, and by some is

considered to be due to a greater degree of infection. There is a greater toxemia. Dogs with this type usually die in from 3 to 4 days after the symptoms have fully developed.

### *Symptoms.*

The first symptoms noted will be a change in the disposition. The kind playful dog will become morose, fretful, and easily excited. In these earlier stages, if running at large, he may pick up and swallow sticks, hair, and even stones. There is a tendency to lick and gnaw the point at which he was bitten. This part may itch and possibly cause pain. He is prone to crawl under the porch or other place and hide a part of the time, coming out to eat and again seeking seclusion. At this stage he may leave home and bite men and animals that chance to come his way. He may return home after several hours in an exhausted state or he may never return. The jaw drops from paralysis and the owner thinks the dog has a bone in his throat. He eats and drinks with difficulty or not at all, owing to the partial or complete paralysis of the throat. He may bark but his bark is drawn out into a long howl. This howl, if once heard, will never be forgotten. The dog may still know his master but has a tendency to try and bite or attack any one he does not know. Later he does not even recognize his master. If in a cage he will bite or snap at any stick poked at him. If tied he will try to chew the rope and free himself. The ears may be erect and tremble. The dog is ever alert to any noise, and is always disturbed by it. He stares, his eyes at first moist later become dry. This is due to the cessation of the tear secretion. Finally he becomes paralyzed, first in the hind quarters, then in the fore, and death ends his suffering. Oftentimes the tongue is protruded and more or less paralyzed and as a result of exposure to the atmosphere is oftentimes dry and black. Figure 1, shows a photograph of a dog with dumb rabies.

### *Furious Rabies.*

In furious rabies the animal is more irritable than in the dumb form. There is a greater tendency to bite. The jaw is not dropped or paralyzed until the very last stages. In the furious type the dog may live from six to eight days after the symptoms are well developed. Horses and cattle more often develop the furious type. The writer has seen a case in the horse, in which an ordinary box stall was not strong enough to hold the animal, so furious was he in his spasms. The horse makes violent efforts to bite or attack, the cow more often tries to butt any animal or person that comes near.

### *Post Mortem Findings.*

The dog, or any animal, to be sent to the laboratory should not be shot through the brain, as that lacerates the brain and causes hemorrhages into its substances. This greatly interferes with a detailed examination. The proper, and one of the most humane ways, is to shoot the dog or other animal through the heart. The head should be cut off in such manner that three or four inches of the neck remains with the head. This enables the securing of the nerve centers for mi-

microscopic study. A sectioned surface of the brain is usually dark in appearance. Occasionally a bloody spot, small in size, can be seen under the coverings of the cord. This is especially noticeable from the cords of the experimental rabbit inoculations, otherwise the cord and brain has a normal appearance. The changes are so slight in their appearance that nothing definite can be told short of a microscopic examination. In the stomach may be found sticks, straws, shavings, etc, picked up while running at large. Aside from these substances, the stomach is empty. There should be observed an absence of all acute diseased lesions, at the autopsy.

### *Microscopical Examination.*

For microscopical examination, the brain must be in good condition. Brains that are in a state of putrefaction cannot be satisfactorily examined. The first definite microscopic lesions of rabies to be pointed out, was by V. Babes in 1892. He found degeneration of the nerve cells in the medulla and the plexiform ganglion. The degeneration in the medulla was particularly noticeable near the central part of the ganglionic portion. There was observed an invasion of small round cells in the spaces occupied by the cytoplasm of the cells. These he called rabic tubercles which are now sometimes called Babes tubercles or corpuscles. Figure 2 shows one of these tubercles from the plexiform ganglion.

In 1893, A. Negri called attention to certain bodies always found in the nerve cells of a dog or other animal dead of rabies. To these was given the name Negri bodies. Since that time these bodies have been studied in more detail by many scientists and are now believed by the foremost workers to be protozoan in nature. Different stages of their development have been studied which corresponds to the different stages of the disease. These bodies stain characteristically. They contain eosinophilic granules. Figure 3 shows nerve cells containing Negri bodies.

Delafield & Prudden call special attention to the peri-vascular infiltration which usually accompanes this condition. Figure 4 gives an illustration of this phase.

### *Animal Experiment.*

When a person is bitten by a dog suspected of being rabid and the laboratory findings are not satisfactory the laboratory worker can, if the brain is still fresh and is not contaminated, inoculate an animal. In doing this an emulsion is made from a small part of a certain part of the brain. The rabbits skull is trephined and a small part of the emulsion is injected under the coverings of the brain. If care in technique is taken the animal will appear healthy, and eat and drink until the symptoms develop, which is usually about the 14th to the 16th day. If the technique has been at fault and infection taken place the rabbit will die of septic infection long before the time for rabies to develop. Freezing does not destroy the virus and it will resist putrefaction for a long time. Drying will soon destroy it.

*Control and Eradication of Rabies.*

This most terrible disease is the most easily eradicated of all contagious diseases as shown by the results in England, where rabies once prevalent, is now practically unknown. As the spread of the disease is by the bite of a dog in practically every instance, the muzzling of all dogs with the destruction of those not kept muzzled, is the easy solution of the problem. This muzzling must be universal throughout the infected district.

*Pasteur Treatment.*

Soon after Pasteur had perfected the vaccine for Anthrax, which was about 1880, his attention was called to a little girl in a ward of a hospital dying of rabies. As a result of the study that followed, Pasteur by experimenting on the lower animals perfected the vaccination method which is still used to vaccinate and protect the lives of people when bitten by a rabid dog. As early as 1880 it was a recognized fact that drying practically destroyed the virus of rabies. Pasteur took advantage of this fact by drying the cord of rabbits dead of rabies, over potassium hydrate thus attenuating it, and making a vaccine. By injecting a certain portion of the cord, so treated for 14 days, under the skin, in the form of an emulsion, followed once a day with a like injection, gradually using cord less attenuated, in 21 days the person is immune from the disease and the treatment is complete.

*Danger of Milk and Meat.*

In regard to the infectiousness of milk from rabid animals it must be considered at all times dangerous, as some experiments have proven that the milk is infectious. Some experiments conducted along this line have given entirely negative results. The young should be taken away from the mother as soon as rabies is found to have developed. The milk should never be used for human consumption. So far, all attempts to produce rabies in experimental animals by feeding them the meat of animals dead of rabies have failed. The virus from the brain mixed with food has in some instances produced rabies experimentally. Rabies has been produced in mice by feeding them rabid brain mixed with their food.