

lated. It is to be remembered that the blood may not show the bacilli in numbers until shortly before death.

(2) **Internal Anthrax.**

(a) *Intestinal Form, Mycosis intestinalis.*—In these cases the infection is through the stomach and intestines, and results from eating the flesh or drinking the milk of diseased animals. The symptoms are those of intense poisoning. The disease may set in with a chill, followed by vomiting, diarrhoea, moderate fever, and pains in the legs and back. In acute cases there are dyspnoea, cyanosis, great anxiety and restlessness, and toward the end convulsions or spasms of the muscles. Haemorrhage may occur from the mucous membranes. Occasionally there are small phlegmonous areas on the skin, or petechiae develop. The spleen is enlarged. The blood is dark and remains fluid for a long time after death. Late in the disease the bacilli may be found in the blood.

This is one of the forms of acute poisoning which may affect many individuals together. Thus Butler and Karl Huber describe an epidemic in which twenty-five persons were attacked after eating the flesh of an animal which had had anthrax. Six died in from forty-eight hours to seven days.

(b) *Wool-sorter's Disease.*—This important form of anthrax is found in the large establishments in which wool or hair is sorted and cleansed. The hair and wool imported into Europe from Russia and South America appear to have induced the largest number of cases. Many of these cases show no external lesion. The infection has been swallowed or inhaled with the dust. There are rarely premonitory symptoms. The patient is seized with a chill, becomes faint and prostrated, has pains in the back and legs, and the temperature rises to 102° to 103°. The breathing is rapid, and he complains of much pain in the chest. There may be a cough and signs of bronchitis. So prominent in some instances are these bronchial symptoms that a pulmonary form of the disease has been described. The pulse is feeble and very rapid. There may be vomiting, and death may occur within twenty-four hours with symptoms of profound collapse and prostration. Other cases are more protracted, and there may be diarrhoea, delirium, and unconsciousness. The recognition of wool-sorter's disease as a form of anthrax is due to J. H. Bell, of Bradford, England.

In certain instances these profound constitutional symptoms of internal anthrax are associated with the external lesions of malignant pustule.

The diagnosis of internal anthrax is by no means easy, unless the history points definitely to infection in the occupation of the individual. In cases of doubt cultures should be made, and inoculations performed in animals. Some of these cases may possibly be caused by organisms other than the bacillus of anthrax (Cornil and Babes).

Treatment.—In malignant pustule the site of inoculation should be destroyed by the caustic or hot iron, and powdered bichloride of mercury

may be sprinkled over the exposed surface. The local development of the bacilli about the site of inoculation may be prevented by the subcutaneous injections of solutions of carbolic acid or bichloride of mercury. The injections should be made at various points around the pustule, and may be repeated two or three times a day. The internal treatment should be confined to the administration of stimulants and plenty of nutritious food. Davies-Colley advises ipecacuanha powder in doses of from five to ten grains every three or four hours.

In malignant forms, particularly the intestinal cases, little can be done. Active purgatives may be given at the outset, so as to remove the infecting material. Quinine in large doses has been recommended.

XXIII. RABIES.

(*Lyssa; Hydrophobia.*)

Definition.—An acute disease of animals, dependent upon a specific virus, and communicated by inoculation to man.

Etiology.—In man the disease is very variously distributed. In Russia it is common, in North Germany it is extremely rare, owing to the wise provision that all dogs shall be muzzled. In England and France it is much more common. In this country the disease is very rare. Since 1867 I have seen but two cases.

Canines are specially liable to the disease. It is found most frequently in the dog, the wolf, and the cat. All animals are, however, susceptible; and it is communicable by inoculation to the ox, horse, or pig. The disease is propagated chiefly by the dog, which seems specially susceptible. In the Western States the skunk is said to be very liable to the disease. The nature of the poison is as yet unknown. It is contained chiefly in the nervous system and is met with in the secretions, particularly in the saliva.

A variable time elapses between the introduction of the virus and the appearance of the symptoms. Horsley states that this depends upon the following factors: "(a) Age. The incubation is shorter in children than in adults. For obvious reasons the former are more frequently attacked. (b) Part infected. The rapidity of onset of the symptoms is greatly determined by the part of the body which may happen to have been bitten. Wounds about the face and head are especially dangerous; next in order in degrees of mortality come bites on the hands, then injuries on the other parts of the body. This relative order is, no doubt, greatly dependent upon the fact that the face, head, and hands are usually naked, while the other parts are clothed. (c) The extent and severity of the wound. Puncture wounds are the most dangerous; the lacerations are fatal in proportion to the extent of the surface afforded for absorption of

the virus. (*d*) The animal conveying the infection. In order of decreasing severity come: first, the wolf; second, the cat; third, the dog; and fourth, other animals." Only a limited number of those bitten by rabid dogs become affected by the disease; according to Horsley, not more than fifteen per cent. On the other hand, the death-rate of those persons bitten by wolves is higher, not less than forty per cent.

The incubation period in man is extremely variable. The average is from six weeks to two months. In a few cases it has been under two weeks. It may be prolonged to three months. It is stated that the incubation may be prolonged for a year or even two years, but this has not been definitely settled.

Symptoms.—Three stages of the disease are recognized:

(1) *Premonitory stage*, in which there may be irritation about the bite, or pain or numbness. The patient is depressed and melancholy; and complains of headache and loss of appetite. He is very irritable and sleepless, and has a constant sense of impending danger. There is often greatly increased sensibility. A bright light or a loud voice is distressing. The larynx may be injected and the first symptoms of difficulty in swallowing are experienced. The voice also becomes husky. There is a slight rise in the temperature and the pulse.

(2) *Furious Stage*.—This is characterized by great excitability and restlessness, and an extreme degree of hyperæsthesia. "Any afferent stimulant—i. e., a sound or a draught of air, or the mere association of a verbal suggestion—will cause a violent reflex spasm. In man this symptom constitutes the most distressing feature of the malady. The spasms, which affect particularly the muscles of the larynx and mouth, are exceedingly painful and are accompanied by an intense sense of dyspnoea, even when the glottis is widely opened or tracheotomy has been performed" (Horsley). Any attempt to take water is followed by an intensely painful spasm of the muscles of the larynx and of the elevators of the hyoid bone. It is this which makes the patient dread the very sight of water and gives the popular name to the disease. These spasmodic attacks may be associated with maniacal symptoms. In the intervals between them the patient is quiet and the mind unclouded. The temperature in this stage is usually elevated and may reach from 100° to 103°. In some instances the disease is afebrile. The patient rarely attempts to injure his attendants, and in the intense spasms may be particularly anxious to avoid hurting any one. There are, however, occasional fits of furious mania, and the patient may, in the contractions of the muscles of the larynx and pharynx, give utterance to odd sounds. This stage lasts from a day and a half to three days and gradually passes into the—

(3) *Paralytic Stage*.—In rodents the preliminary and furious stages are absent, as a rule, and the paralytic stage may be marked from the outset—the so-called dumb rabies. This stage rarely lasts longer than from six to eighteen hours. The patient then becomes quiet; the spasms no

longer occur; there is gradual unconsciousness; the heart's action becomes more and more enfeebled, and death occurs by syncope.

Morbid Anatomy.—The lesions are in the cerebro-spinal system. The blood-vessels are congested; there is perivascular exudation of leucocytes; and there are minute hæmorrhages. According to Gowers, these are particularly intense in the medulla. The pharynx is congested, the mucous membrane of the stomach is hyperæmic, and not infrequently covered with a blood-stained mucus. The larynx, trachea, and bronchi show acute congestion. There are no special changes in the abdominal or thoracic viscera. The inoculation experiments show that the virus is not present in the liver, spleen, or kidneys, but is abundant in the spinal cord and brain.

Treatment.—Prophylaxis is of the greatest importance, and by a systematic muzzling of dogs the disease can be, as in Germany, practically eradicated.

The bites should be carefully washed and thoroughly cauterized with caustic potash or concentrated carbolic acid. It is best to keep the wound constantly open for at least five or six weeks. When once established the disease is hopelessly incurable. No measures have been found of the slightest avail, consequently the treatment must be palliative. The patient should be kept in a darkened room, in charge of not more than two careful attendants. To allay the spasm, chloroform may be administered and morphia given hypodermically. It is best to use these powerful remedies from the outset, and not to temporize with chloral, bromide of potassium, and other less potent drugs. By the local application of cocaine, the sensitiveness of the throat may be diminished sufficiently to enable the patient to take liquid nourishment. Sometimes he can swallow readily. Nutrient enemata may be administered.

Preventive Inoculation.—Pasteur has found that the virus, when propagated through a series of rabbits, increases rapidly in its virulence; so that whereas subdural inoculation from the brain of a mad dog takes from fifteen to twenty days to produce the disease, in successive inoculations in a series of rabbits the incubation period is gradually reduced to seven days. The spinal cord of these rabbits contains the virus in great intensity, but when preserved in dry air the virus gradually diminishes in intensity. If now dogs are inoculated with cords preserved for from twelve to fifteen days, and then with cords preserved for a shorter period, i. e., with a progressively stronger virus, they gradually acquire immunity against the disease. A dog treated in this way will resist inoculation with material from a perfectly fresh cord from a rabid rabbit, which otherwise would inevitably have proved fatal. Relying upon these experiments, Pasteur began inoculations in the human subject using, on successive days, material from cords in which the virus was of varying degrees of intensity.

There is still much discussion as to the full value of this method, but if the protective inoculation can be successfully performed in dogs,

there is no reason why the same should not hold good for man; and the figures published annually from the Pasteur Institute show that in persons bitten by animals known to have been rabid, the mortality after inoculation is only about 0.60 per cent.

Pseudo-rabies.—This is a very interesting affection, which may closely resemble hydrophobia, but is really nothing more than a neurotic or hysterical manifestation. A nervous person bitten by a dog, either rabid or supposed to be rabid, develops within a few months, or even later, symptoms somewhat resembling the true disease. He is irritable and depressed. He constantly declares his condition to be serious and that he will inevitably become mad. He may have paroxysms in which he says he is unable to drink, grasps at his throat, and becomes emotional. The temperature is not elevated and the disease does not progress. It lasts much longer than the true rabies, and is amenable to treatment. It is not improbable that a majority of the cases of alleged recovery in this disease have been of this hysterical form. In a case which Burr reported from my clinic a few years ago the patient had paroxysmal attacks in which he could not swallow. He was greatly excited and alarmed at the sight of water and was extremely emotional. The attack lasted for a couple of weeks and yielded to treatment with powerful electrical currents.

XXIV. TETANUS.

(Lockjaw.)

Definition.—An infectious malady characterized by tonic spasms of the muscles with marked exacerbations. The virus is produced by a bacillus which occurs in earth and sometimes in putrefying fluids and manure.

Etiology.—It occurs as an idiopathic affection or follows trauma. It is frequent in some localities and has prevailed extensively in epidemic form among new-born children, when it is known as tetanus or trismus neonatorum. It is more common in hot than in temperate climates, and in the colored than in the Caucasian race. This is particularly the case with tetanus following confinement and in tetanus neonatorum. In certain of the West India Islands more than one half of the mortality among the negro children has been due to this cause. In a majority of the cases there is an injury which may be of the most trifling character. It is more common after punctured and contused than after incised wounds, and frequently follows those of the hands and feet. The disease usually appears within two weeks of the injury. In some military campaigns tetanus has prevailed extensively, but in others, as in the late civil war, the cases have been comparatively few. Idiopathic tetanus is rare in man, but it has sometimes followed exposure to cold or after sleeping on the damp ground.

The infectious nature of tetanus was suggested by its endemic occurrence and from the manner of its behavior in certain institutions. Veterinarians have long been of this belief, as cases are apt to occur together in horses in one stable. In the United States attention was early called to this feature by the prevalence of the disease in the eastern end of Long Island.

The Tetanus Bacillus.—The observations of Rosenbach, Nicolaïer, and Kitasato have demonstrated that there is in connection with the disease a specific organism which can be isolated and cultivated. The bacillus forms a slender rod with rounded ends and may grow into long threads. It is a motile, grows at ordinary temperatures, and is anaërobic. With small quantities of the culture the disease may be transmitted to animals, which die with symptoms of tetanus. An extremely interesting fact is the separation by Brieger, from the cultures as well as from a subject dead of tetanus, of poisonous substances capable of producing the disease. Of these ptomaines one, *tetanin*, causes the characteristic symptoms of tetanus; another causes tremors, convulsions, and subsequently paralysis; and a third causes at once intense clonic and tonic spasms. Another point of interest is the fact that protection in animals can be procured by inoculating an animal with the blood of another which has had the disease. The organism has been found in the earth and in putrefying fluids, and Nicolaïer has caused the disease by inoculating with different sorts of surface soil.

Morbid Anatomy.—No characteristic lesions have been found in the cord or in the brain. Congestions occur in different parts, and perivascular exudations and granular changes in the nerve-cells have been found. The condition of the wound is variable. The nerves are often found injured, reddened, and swollen. In the tetanus neonatorum the umbilicus may be inflamed.

Symptoms.—After an injury the disease sets in usually within ten days. In Yandell's statistics at least two fifths, and in Joseph Jones's four fifths, occurred before the fifteenth day. The patient complains at first of slight stiffness in the neck, or a feeling of tightness in the jaws, or difficulty in mastication. Occasionally chilly feelings or actual rigors may precede these symptoms. Gradually a tonic spasm of the muscles of these parts develops, producing the condition of trismus or lockjaw. The eyebrows may be raised and the angles of the mouth drawn out, causing the so-called sardonic grin—*risus sardonicus*. In children the spasm may be confined to these parts. Sometimes the attack is associated with paralysis of the facial muscles and difficulty in swallowing—the head tetanus of Rose, which has most commonly followed injuries in the neighborhood of the fifth nerve. Gradually the paroxysms extend and involve the muscles of the body. Those of the back are most affected, so that during the spasm the unfortunate victim may rest upon the head and heels, a position known as *opisthotonos*. The rectus abdominalis muscle has been torn across in the spasm. The entire trunk and limbs may be perfectly rigid—*orthoto-*