

the injured parts. Thirty-nine healed in eight days. In these the gum tissues were healthy. The pus had no effect. The wounds healed as rapidly as any wounds possibly could. In seven the gums were inflamed and infection occurred. Suppuration was slight in four and considerable in three. The pathologic findings in these cases were not unlike inflammation and infection in other tissues. Similar results would, no doubt, have taken place if inoculation had been performed with pus from an abscess. The last three dogs were allowed to depart at the end of four weeks with slight pus infection.

While hundreds of slides could be adduced in support of this chain of evidence, sufficient have been given to permit of the introduction of evidence from other phases of the subject.

(To be continued.)

ANTHRAX, WITH REPORT OF A CASE.*

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Anthrax is one of the rare but very interesting maladies afflicting the human race which few physicians have the opportunity of seeing in the active form. It is an acute, parasitic, infectious disease, known also by the synonyms of malignant pustule, splenic fever, rag-pickers, wool-sorters and furriers' disease, also Milzbrand and carbunculosus contagiosus and a number of others. As to its history and antiquity we know but little, but that it has existed for centuries there can be no doubt.

Blanc states that he finds our modern anthrax to have been the disease of the Egyptian plagues, but Hamlet on the other hand thinks this is only a matter of speculation.

To the researches of Pollender in 1855 and Davine in 1863 belong the credit of the discovery of the *B. anthracis*, the positive and only direct factor in the production of the disease. It has been said by good authority, that the discovery of, and experiments with, the *B. anthracis* has resulted in contributing more to our knowledge of bacteriology in general than work upon any of the other infectious diseases.

The *B. anthracis* is a non-motile minute rod-shaped body, ranging in length from 2 to 3 up to 40 or 50 microns, and presenting the appearance when stained of a strand of beads.

In persons or animals suffering from this disease, the bacillus may be found in the pustules, blood, urine, feces and tissues, especially the spleen, liver and lungs. When taken from these sources it can be developed in pure culture, which, if some other susceptible animal be inoculated will produce identically the same condition as that found in the animal from which it was taken. When taken direct from the pustules or from any part of the animal suffering from the disease, it is in the form of short rods and square at the ends, the diameter being greater and the length shorter than the pure culture cultivated artificially. If cultivated artificially, as it can be on any of the ordinary culture media in eighteen to twenty-four hours at the temperature of the body which is most favorable for its rapid development, the short rods develop into long threads and remain in this condition until a change in surroundings occur, the most important being a diminution in the nutritive supply which favors the production of spores.

Abbott says that spores will not form in a temperature under 12 C., or above 43 C. Spores do not form within the body of living animals, but spores introduced into living animals produce the disease. These spores are capable of resisting very deleterious influences. Esmarch says, spores from some sources can be killed by exposure to steam one minute, while others resist the same temperature for twelve minutes. These spores have been seen to continue in the living though inactive condition for long intervals and retain their virulent qualities.

Billings says that in 1876 he inoculated a piece of silk ligature with the anthrax spores and placed it in a bottle which was subjected to no other changes than those in the room in which it was kept. At various times during the seventeen years that followed, he cut bits of the ligature and placed it under the skin of a rabbit, and in every instance was the disease anthrax produced in typical form and the animals died, the last being in 1893 with similar results. He also cites another instance, in which he claims a horse became infected from having worn a harness made from the skin of an animal that died with anthrax.

Within the past ten days I examined a culture of anthrax developed from a tube in which I had inoculated direct from a patient Oct. 22, 1897. The tube of agar-agar from which the culture was made had remained in my office all this time, 3½ years, and for the past 18 months had been concealed in an air-tight box. The contents of the tube had so dried up that it was a mere thin shell and a piece of this placed in a fresh tube gave an excellent culture in twenty-four hours.

As to its virulency at the present time I can not say as I did not inoculate any animal, but a culture from the same tube in November, 1897, when tested by Professor Kramer, proved sufficiently virulent to kill a mouse in about twenty-four hours.

As to the formation of toxins there are some differences of opinion. Most bacteriologists claim the bacillus of anthrax generates toxins, while Conradi¹ says we have no evidence to prove the general assumption that the bacillus of anthrax generates a toxin. On the contrary everything tends to indicate that the anthrax bacillus is a typical infectious micro-organism. As to the etiology there is but one direct factor and that is the bacillus of anthrax, which is introduced into the person or animal, either from some other person or animal suffering from it, or who resided in an anthrax center, or from some of the earth, vegetation or water from one of these centers, which simply means localities where the bacillus is found in the earth.

Cattle and horses nearly always contract the disease while grazing over these localities, or in drinking water found in cess pools or near them.

The conditions which seem most favorable for their development in the earth are, 1, presence of the bacillus of anthrax; 2, a rich black loamy soil with sufficient moisture and high temperature; 3, profuse vegetation and rapid decay of same.

The season of the year most favorable for the development of the bacillus in the soil is from about the middle of July to the middle of October. In seasons in which prolonged drouth and high temperature have been preceded by much rain and luxuriant vegetation.

These centers are most frequently found in the torrid zones, less frequently in the temperate zones, and occa-

* Read before the Alumni Association of the Cincinnati College of Medicine and Surgery, May 1, 1901.

1. THE JOURNAL A. M. A., Sept. 23, 1899.

sionally found in the frigid. It has been shown to exist in Siberia and Lapland. In our own country, as far as is known, there are four well-established centers in Canada, namely, Guelph, Acton, Listowell and Kingston.²

Within the United States it has been found in Massachusetts, Pennsylvania, Virginia, Maryland, Michigan, and most of the states lying in the Mississippi valley; also California had an outbreak some two years ago which resulted in the loss of many cattle. In Ohio no doubt there have been various cases, but I have not been able to find any account in medical literature of any case, except the one which came under my observation and treatment about three and a half years ago.

From all the inquiry and investigation of the same community from which this case came there is nothing to show that there had ever been any disease in any person similar, but there is a history of some form of infection in the horse from which this patient became infected. The symptoms of the horse were extensive edema of head and part of the neck, and a profuse purulent discharge from the nostrils, mouth and eyes, which lasted



Fig. 1.—One hundred and twenty hours after inoculation.

nearly two months and ended in recovery. No examination either by veterinarian or physician had been made of this animal, but from the similarity of the symptoms and the fact that the patient contracted the disease by being switched in the face by the same horse, shows strong suspicions that the affection of the horse was anthrax.

SUSCEPTIBILITY AND IMMUNITY.

The susceptibility of the mammalia to anthrax may be expressed in the following order: herbivora, omnivora, and carnivora. This is largely due to the manner of obtaining food and modified much by the kind of food and locality from which it is obtained. Mice, guinea-pigs, and rabbits are most highly susceptible, and the ones used for experiments.

An injection of virulent anthrax in any of these animals will produce death in twenty-four to forty-eight hours. In man, while not the most susceptible, nor by any means immune, when fatal results do come, it is usually within ten days from time of inoculation. Patients passing beyond this time usually recover, but rather slowly, on account of the loss of tissue from sloughing and gangrene.

A patient is not rendered immune by one attack and is just as liable to a second or third attack as the first.

Invasion.—There are three common avenues for the introduction of the poison: 1, through abrasions of the cutis, or wounds of any kind; 2, digestive tract; 3, respiratory tract.

Incubation.—The period of incubation in animals as in man is from a few hours to several days. This is modified by the amount of bacilli introduced, by the degree of their virulency, and the rank held by the person or animal in regard to susceptibility or immunity.

Clinical History.—Two leading clinical types are distinguished, namely external and internal. A clinical report of the two following cases will fairly illustrate the symptoms and conditions of both varieties, though



Fig. 2.—Eighteenth Day.

both were inoculated externally; one in the right eye, the other in the left, and both cases showing marked external edema in about the same degree.

The case in which but few internal symptoms developed showed more severe external symptoms and recovered, while the case with the most marked internal symptoms resulted fatally on the fifth day after inoculation, which is shown in the report of the following case, also reported elsewhere.³

C. B., aged 59, a native of Germany, and laborer in a hair factory, came to the Johns Hopkins Hospital Dispensary on Saturday, May 11, 1895, complaining of the swelling of the lids of the right eye. His history was as follows:

Family History.—His father and one brother died of some lung trouble, the exact nature of which he does not know; one brother died of cancer of the liver. The family history is otherwise negative.

Present History.—Two days ago, while working with South American hair he scratched his right eye with his hand, as it was itching. The next morning he noticed that the eyelids

2. Dr. W. T. Connell, in THE JOURNAL A. M. A., Dec. 9, 1899.

3. Johns Hopkins Bulletin, Sept.-Oct. No., 1895.

were slightly swollen, and itchy, and by this morning they were so swollen that he came to the dispensary.

At the time of the visit the swelling was confined to the lids of the right eye, and was fairly sharply localized; it was edematous in character, and quite boggy, the overlying skin appearing almost of a natural color. Two small incisions were made, one into each lid, and a small quantity of rather thin, whitish fluid, resembling diluted milk was evacuated. Cultures upon agar-agar were made at this time, and two days later the tube inoculated showed a pure growth of an organism which resembled the bacillus anthracis, and which upon inoculation killed a mouse in twenty-four hours. Further tests proved it to be the anthrax bacillus.

The patient was admitted to the hospital on May 13, four days from the onset of the disease. The physician who attended him at his home, from Saturday until his admission on Monday, stated that his temperature had been subnormal during the entire period. On admission the patient complained of nothing but slight pain beneath the right side of the jaw; otherwise he felt perfectly comfortable. He had no headache or malaise. His mind was perfectly clear. The following note was made at this time:

Patient is in bed on his back. Temperature 102 F. Pulse 132 per minute, regular, volume fair, tension not increased. Respirations 16 per minute, easy. Tongue has a slight white coat. The mucous membranes are of a fair color, not cyanosed.

Both eyes are closed by edema. On the left side the swelling is not so nearly marked as on the right side, the lids being distended by a moderately firm, watery edema. The lids of the right eye are much swollen, hard and tense, and the overlying skin is occupied by several vesicles, varying in size from a pea to a bean, and filled with clear, yellowish serum. The eyes themselves appear uninvolved. Over the whole of the right side of the face and neck, and extending up onto the scalp, is a marked edema of varying consistency; immediately around the right eye it is very hard, and covered by tense, shiny skin; over the forehead, neck and remainder of the face, as well as over the implicated scalp, it is much less firm, and can be easily pitted by pressure. The edema extends across the left side of the forehead, and occupies the neck as low down as the clavicle. On the side of the mouth the right cheek is marked with the imprints of teeth, and has a yellow-gray sloughy appearance.

May 14, 10 a. m. The patient is much worse this morning. He had several involuntary passages of urine and feces during the night. The mind is quite clear, and he answers questions rationally. He complains a good deal of cramp-like pains in the abdomen. The pains are situated in the umbilical region, and are sharp and constant, with occasional acute exacerbations, during which he has a desire to defecate. The abdomen is extremely sensitive to pressure this morning. The spleen can not be palpated. The pulse at the wrist is almost imperceptible and practically uncountable. The heart sounds are extremely distant and feeble. The temperature has been subnormal since 4 a. m. this morning and is now 97 F. The right eye is somewhat more swollen than it was yesterday, and the edema now occupies the whole of the scalp, and has spread down the right side of the chest to the level of the pectoral fold; it also occupies all the tissues overlying the upper part of the sternum.

The patient gradually sank, and died quietly at 4 p. m. on the 14th. Before death the edema had spread further over the left cheek, and had also extended somewhat further down the chest. The patient became very cyanotic before death. There was no respiratory distress at any time. His mind was perfectly clear to within fifteen minutes of his death. On the morning of the 14th he had three loose watery stools of grayish color, and apparently containing no blood. The urine was passed involuntarily, and could not be examined.

Autopsy, May 15, eighteen hours after death, the body in the meanwhile having been preserved on ice. Body 174 cm. long, moderately well nourished, strongly built. Rigor mortis in both extremities. The right eyelids are edematous, closing the eye; they are congested and glazed and the epidermis is peeling off. The whole right side of the face below the eye is edematous, and the edema extends over the head and neck. The left eye and left side of the face are less swollen. The edema is well marked anteriorly over the neck and clavicles,

and can be well followed down the chest. On incising the skin, above the clavicles, much clear, serum-like fluid escapes. The edema extends beyond the median line to the left, and is immediately evident after incision, extending to the sternum. Subcutaneous fat is moderate in amount.

The peritoneal cavity contains turbid fluid; at least 2000 c.c. of such fluid is present in the cavity. The serosa is injected, its reflection lost, the vessels very hyperemic. Smaller and larger ecchymoses are seen beneath the serous membrane. In the smaller omentum, in the region of the pancreas, a large ecchymosis is seen.

In the pyloric region there is in the mucous membrane a large, deeply congested area, measuring 8x6 cm. in extent. It is not clear that there is a false membrane over it, but some grayish-yellow material adheres to the surface.

The duodenum is congested uniformly. Beginning in the jejunum, which is less congested, there occur at intervals small, elevated, deeply congested areas. They average 2 mm. in width and project 1 mm. above the surface of the intestines; they do not seem to correspond with the lymphatic follicles. The serosa over them is often the deeply congested, bulged out portion already described; this is, however, not exclusively the case. These foci are quite numerous in the jejunum, at least fifteen being present in this part of the gut alone. At times two or three were close together, though as a rule they were more separated. In the ileum they were also seen, in this situation perhaps a little more separated, but in all as many were present as in the jejunum. In connection with one of these areas in the ileum, what appeared to be a false membrane occurred. If a membrane, it was thin, and easily scraped away. Several of the nodules showed superficial ulceration. There was no relation detected to the lymphatic apparatus, and the nodes were less numerous near the ileo-cecal valve. The large intestine shows no such localized foci, only a diffuse congestion. Mesenteric glands were swollen, congested, hemorrhagic, and softened.

The second case is the one that came under my observation and treatment three and a half years ago.

Elmer C., aged 20, farmer of good habits, health and family history, came to me on Thursday, 7 a. m., October 21, 1897, with the following history:

On October 18, four days before, while working with a team of horses in the field he was standing directly behind them unloading the wagon. One of the horses switched him in the face, which caused quite a burning and itching sensation, about like the bite of an insect. This occurred about 11 a. m., and he continued to work the remainder of the day with no other symptoms than those of the burning and itching which were present at first.

October 19, edema of lower left eyelid with the appearance of small ecchymotic spot about three-fourths inch below center of eye. Patient worked all day, and by evening the eye was almost closed.

October 20, burning and itching same as first two days. Eye completely closed, pustules formed over lower lid. Edema had spread in all directions and slight discharge from the eye. At 4 p. m. patient applied for treatment to physician, who claimed to have removed a piece of glass from the eye which, if correct, had never produced any pain.

October 21, about 7 a. m., patient came to my office for treatment the first time. The left eye was completely closed, with marked edema of face and head, the left side being much worse than the right. The lids looked watery, and there was a profuse purulent discharge from the left eye resembling gonorrheic ophthalmia, and numerous pustules from one-eighth to one-half inch in diameter covering the lower lid and extending about two inches over the cheek. Some of the pustules had ruptured, and the base showing the slough had extended to the tissue beneath the skin. Temperature 101; pulse 96; respiration 20. No headache nor pain, but patient was restless. Patient grew worse all day, and the following morning, October 22, I saw him at his home. By this time the swelling had spread over the entire face and scalp and as low as the clavicle, and was sufficient to produce difficult and labored breathing. Temperature 102; pulse 102; respirations

25. Tongue heavily coated, breath fetid, no appetite and very restless. Had slept but very little during the night. The discharge from the eye and sloughing areas was very profuse. At this time I prepared two slides, one from the fluid of a pustule and one from the pus discharging from the eye. Upon microscopical examination, both slides showed the short, thick rods of bacillus anthracis. In the evening of the same day I inoculated a tube of agar-agar, and after eighteen hours, examination showed the presence of bacillus of anthrax in large numbers, and upon this I based and made my diagnosis of anthrax.

October 23, edema increasing. Both eyes completely closed; discharge greater; pustules still forming, and could now be seen in all the stages, a very interesting condition to observe. The mucous surface of the left side of the mouth was covered with a grayish-white membrane resembling diphtheria and the surface would bleed freely when this was removed. Temperature 102.5; pulse 120; respirations 28, deep and labored. Very restless, some dyspnea and vertigo on rising. Could speak but little louder than whisper. Could not take any nourishment on account of swelling of mouth and throat. Photograph No. 1 shows condition of this day.

October 24, condition same as preceding day, except breathing was heavier and edema still increasing.

October 25, conditions same as before, except the swelling of the right eye was reduced sufficient to permit it to open slightly, but the edema had spread over the entire chest as low as the apex of the heart, and presented a bright red appearance resembling the rash of "iodism." Slight pain also developed in the bowels, which lasted for thirty-six hours. This was the only pain experienced during the course of the disease.

October 26, edema decreasing, discharge about same. Temperature 100; pulse 100, respirations 22. Voice better. Can take small amount of diet, and getting some natural sleep. Within the next twenty-four hours temperature went to normal, and never rose above 99, and improvement continued until patient was in good health.

On the tenth day a line of demarcation formed as shown in photograph No. 2. Within this line everything was gangrenous, except the eyeball and the deeper portion of the eyelids.

The sight of the eye was at no time affected, although the eyeball was highly congested. The gangrene destroyed all the soft tissue over the cheek, to the periosteum, and all the muscles about the eyes that control the lids.

Dr. Stuber, of Lima, Ohio, directed and treated the eye and has made three plastic operations, hoping to restore better functions of the eyelids, but the results have not been satisfactory.

Treatment.—Having no experience in any way with this affection and finding but little literature on the subject that seemed to meet the symptoms present, a line of symptomatic treatment was adopted, which consisted of quinin, whisky, diuretics and cathartics, internally and externally, local application of bichlorid cloths to all parts that were sloughing, boracic acid salve to the eye, after thoroughly cleansing all the discharge from the eye with hot boracic acid solution.

On the eighth day after inoculation I found an article by Vockresensy,⁴ in which he highly eulogizes the use of large doses of carbolic acid internally, claiming to have cured sixteen consecutive cases of malignant pustule, and in some it was not begun until the seventh day.

In my case it was not used until the eighth day; within twenty-four hours from the time of commencing it improvement was noticeable, and it was continued until all symptoms of sepsis had disappeared. Whether the favorable result was due to use of the carbolic acid, I do not know, but should I get another case I would begin it promptly.

The main points of interest are: 1. Does this one case prove that an anthrax center exists on this farm, the home of the horse and patient? 2. Did the horse really have an anthrax at the time he was suffering from the swelling and discharge from the head? 3. The difference in the symptoms and results of the two cases reported when the points of inoculation were so nearly the same. The virulency in either case proved to be sufficient to produce death in mice in twenty-four hours.

INTERESTING THROAT PARALYSES IN A CASE OF LOCOMOTOR ATAXIA OF AN IRREGULAR FORM.*

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CHICAGO.

Mr. F. D. R., aged 35, railroad employe, was sent to me Jan. 26, 1901. About four days previous to his visit he began to cough occasionally and had at that time noticed some difficulty in articulation, especially in the liquid sounds, *t* and *d*; the labials *m* and *n* were pronounced easily. At this time there was noticed occasional though slight regurgitation of liquids into the nasal cavity on swallowing. He gave a history of rheumatic pains in the shoulder some four or five years ago, but had had none recently.

He confessed to an attack of gonorrhea, but had never had syphilis, nor were there any general symptoms indicating such an attack. His habits were good; he did not use alcoholics, and used very little tobacco. His sense of hearing was good; the sense of smell was considerably impaired; vision in the right eye was poor.

There were no pains at this time from which he suffered, but he had had sharp lancinating pains in the lower extremities at one time for several years. His normal weight was 150 pounds, but now he weighed only 135 pounds. His strength was fairly good; the temperature and pulse were normal. There was no dyspnea, vertigo, or headache.

He complained of a slight tickling sensation in the larynx, which excited cough occasionally. The tongue was slightly coated, the appetite fair, the digestion good, but he was habitually constipated. Micturition was frequent and could not be controlled very well.

Dr. C. D. Wescott, who sent him to me, reported upon his case as follows: "In regard to the case of F. D. R., I would say that he was referred to us last May, by Dr. Patrick. He came with the diagnosis of locomotor ataxia, and was sent to us because of a drooping of the upper lid of the right eye and a divergence of the same eye. He was also complaining of pains in the eyes and head. He said that the eye first turned out two years before and had not been straight since. Upon examination, it was found that there was complete paralysis of the branches of the third nerve of the right side. The ophthalmoscope showed some opacities in the vitreous in the right eye and the retinal vessels were full and hazy in outline. The optic nerves appeared normal in both eyes. We prescribed glasses which gave him great relief in the use of his eyes for near work; and, about the middle of June, he reported himself decidedly better. There was noticeably less ptosis and slight movement of the right eye in was possible. We then lost sight of him, and he did not return until we sent him to you on January 26 complaining of his throat. On that day there was almost com-

4. Annual of the Universal Med. Sciences, 1891, vol. iii.

* Read before the Chicago Laryngological and Climatological Society, May 2, 1901. (See Proceedings, p. 1801.)