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## ANTHRAX IN ANIMAL (HORSE) HAIR

THE MODERN INDUSTRIAL AND PUBLIC HEALTH  
MENACE

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During the World War it was found that shaving brushes manufactured of horsehair contained the germs (spores) of a most fatal disease, and through this source a number of persons were inoculated with anthrax. This led to a careful investigation by the department of health of the animal hair used in brush manufacture. It was found in frequent instances, particularly with horsehair that had been imported, that hair cloth, hair braid and various kinds of brushes, especially toilet brushes (in the majority of instances shaving brushes) made from this material, were contaminated with dirt containing the spores of anthrax.

In New York City in the last seventeen months there have been reported to the division of industrial hygiene of the department of health thirty-four cases of human anthrax, of which eleven have been fatal. The accompanying table indicates the sources of danger from this disease. The table presents in chronological order the thirty-four cases of anthrax occurring in New York City during 1919 and 1920, a period of one year and five months, and shows briefly the name, age, sex, date of occurrence, source of infection and result.

A campaign of education of those who are engaged in the manufacture of brushes, particularly those using horsehair, was undertaken in order to secure general cooperation in an endeavor to annihilate this modern industrial and public health menace at its source. It was little appreciated how dangerous it is to handle horsehair, as workmen who had been at a trade for long periods and not experiencing such results were loath to believe that there could be danger. The appearance of case after case brought this fact home to employer and employee, as well as to the public health officials. After a careful study of this matter, the New York City Department of Health adopted the subjoined statute:

At a meeting of the Board of Health of the Department of Health of the City of New York, held in the said city on the 16th day of June, 1920, the following resolution was adopted:

### SPECIAL REGULATIONS

*Resolved*, That Article 12 of the Sanitary Code be amended by adding thereto a new section to be known as Section 230 and to read as follows:  
Sec. 230. *The manufacture and sale of hair brushes and hair cloth.*  
—No person shall use in the manufacture of brushes or cloth, any animal hair which has not been sterilized by a process prescribed or approved by the Board of Health nor shall any person bring into,

or offer for sale, sell or deliver in the City of New York, any brush or cloth containing animal hair unless the same shall have been so sterilized.

It shall be the duty of the manufacturer of shaving brushes, tooth brushes, hair brushes, nail brushes, or other toilet brushes intended for human use, to cause his name or trade mark, the place of manufacture, and the word STERILIZED to be permanently, clearly and legibly painted or branded upon every such brush before offering for sale, selling, or delivering the same in the City of New York. Provided, however, the word STERILIZED shall not be painted or branded upon any such brush unless the animal hair used in the manufacture thereof shall have been sterilized by a process prescribed or approved by the Board of Health.

No person shall sell, offer for sale, or deliver, or have in his possession with intent to sell, offer for sale, or deliver in the City of New York, any shaving brush, tooth brush, hair brush, nail brush, or other toilet brush intended for human use, containing animal hair, unless the name or trade mark of the manufacturer, place of manufacture, and the word STERILIZED are permanently, clearly and legibly painted or branded thereon.

The provisions of this section shall take effect the 1st day of July, 1920, but shall not apply to brushes in stock on the 16th day of June, 1920, in the hands of dealers which have not been labeled or branded, as hereinbefore required.

WHEREAS, This board has adopted Section 230 of the Sanitary Code relating to the manufacture and sale of hair brushes and hair cloth and the protection of the public against anthrax; and

WHEREAS, The provisions of said section require all hair used in the manufacture of brushes and cloth to be sterilized by a process prescribed or approved by this board; and

WHEREAS, An investigation conducted by the Department of Health indicates that so far as can be ascertained at this time only two processes have been found to be effective and adequate to properly sterilize such hair and to render the same free from anthrax bacteria and spores; and

WHEREAS, The two processes referred to are as follows, to wit:

1. Boiling the hair in water maintained at a temperature of 212 F. for a period of at least three hours.
2. The placing of the hair in an autoclave in which a 10-inch vacuum is produced. Live steam to be then turned on and kept at 15 pounds pressure for a period of three hours; be it therefore

*Resolved*, That the following processes for the sterilization of hair to be used in the manufacture of brushes or cloth and relating to the provisions of Section 230 of the Sanitary Code, be and the same are hereby approved, to wit:

1. Boiling the hair in water maintained at a temperature of 212 F. for a period of at least three hours.
2. The placing of the hair in an autoclave in which a 10-inch vacuum is produced. Live steam to be then turned on and kept at 15 pounds pressure for a period of three hours.

It was anticipated that a regulation of this character, if not understood by those interested, would materially injure the brush trade which, owing to general labor unrest and upward tendency of prices, was having its own share of trouble. Regulations were drawn and placed in effect after a conference with brush manufacturers, and a number of visits were made to factories and special talks given to the workmen in these establishments; in addition, literature was printed and was disseminated in channels that would reassure, while informing without causing confusion.

A visit was made to several of the brush men's conferences (Troy and Northampton), and correspondence was held with neighboring states similarly interested in this unpleasant condition. The regulation was given publicity through the newspapers, each case of human anthrax as it appeared being specially featured. This public health feature of the work was well received, and aid was given freely by all concerned, even by

those hard-headed, experienced workmen who are at times so persistent in continuing a practice simply from habit, and who will not change or alter their methods until imminent dangers squarely placed before them make them alter their usual methods.

#### NATURE OF ANTHRAX

Primarily, anthrax is an animal disease, frequently transmitted to man, not in the sense that the animal is the host, but that the animal is its victim, from which by accident man receives the infection. Naturally, then, the source of anthrax in man is most often looked for in the products of the animal—in hides, wool or hair. Anthrax is widespread, affecting cattle, sheep and horses most often, and less frequently men. We are informed that all herbivora are liable to anthrax, but that carnivora enjoy relative immunity. Domestic animals, cats, dogs and pigs often fall victims to anthrax, probably from their intimate contact with the soil or from eating infected meat. Experiments in the laboratory demonstrate that rabbits, mice and guinea-pigs are peculiarly susceptible to anthrax.

Anthrax in medical history is an ancient affair, and from the earliest times has been considered a scourge to both men and beasts. Today anthrax is being disseminated through a source but little suspected by the general public and especially by the medical profession. Brushes used in toilet and domestic use, as well as hair cloth and hair braid, have recently in New York City caused a number of cases of this disease.

#### SOURCE OF INFECTION

Originally, anthrax was probably telluric; but, rising to the surface, it infected pasture lands and through grazing, was taken up by animals and disseminated. Lands rich in organic matter seem best suited for the growth of anthrax. Fields may be contaminated through hay or seed from infected areas or from carcasses of animals not deeply buried, the ground water probably carrying the organisms of anthrax to the surface. According to Kitasato, sporulation in the ground is incomplete at from 18 to 20 inches beneath the surface of the soil.

Anthrax in an infected animal may be disseminated through the urine, feces and other body discharges. Arntz found anthrax organisms in the saliva of an infected horse, and others have found the organisms in cow's milk. Anthrax may be disseminated in the excrement of carrion birds, which may contain anthrax spores. Sucking insects, especially flies, may similarly disseminate the disease.

No doubt the greatest danger from anthrax lurks in hides; and in this particular industry the menace is well known and guarded against, as evidenced by the fact that millions make or wear gloves, shoes and articles from hides, such as traveling bags, but comparatively few contract anthrax. In both American and English investigations, no infection has been reported among the thousands of workers in the glove and shoe industries.

A recent menace, which about a year and a half ago attracted our attention, was the dissemination of anthrax through the handling or use of brushes and cloth made of horsehair. The cheap horsehair shaving brush has been the principal offender in this regard, but other brushes with contaminated hair have occasioned a number of cases, and a new horsehair brush of any kind used for toilet purposes should be sterilized carefully before it is used.

Direct contact with the infected animal is not essential, as infection may occur through dirt or dust contaminated with the anthrax spore or germ.

Manufacturers of hog bristle brushes are of the opinion that hog bristles rarely, if ever, disseminate anthrax. This may be true, as the method of collecting, treating and preparing hog bristles for toilet brushes probably removes this contamination; but the material so removed, unless sterilized, may be the means of seeding places for the future infection of either man or beast.

Every object to which anthrax spores can be attached becomes a source of danger and is liable to cause the spread of this disease at any time; therefore it is most essential that this menace should be known and anticipated by all.

#### METHOD OF PREVENTION

Animal hair is usually purchased by weight, and in the original packages imported there is considerable foreign material—dirt. This may be the means of disseminating the disease unless the dirt is destroyed when the hair is taken from the container and the container sterilized or destroyed by fire.

Shaving brushes made of horsehair or a mixture containing horsehair have caused eighteen of the thirty-four cases, with nine fatalities—a mortality of 50 per cent. There was laboratory confirmation in every instance.

Numerous samples of horsehair and brushes made of horsehair—especially shaving brushes made of horsehair—have been tested and have been found in 80 per cent. of the cases to be positively contaminated with the spores of anthrax. This indicates conclusively that horsehair used in brush manufacture, especially shaving brushes unsterilized or improperly sterilized, is a positive menace.

In our experience the use of a new shaving brush, made of horsehair or a mixture containing horsehair, in the home or in the public barber shop, is a matter calling for prompt and drastic action by our public health authorities. Suggestion has been made that all shaving brushes made of horsehair should be excluded from sale and their future manufacture interdicted, and that horsehair used in making other brushes should in every such instance be carefully sterilized. Exclusion of such contaminated material from commerce is difficult or impossible. Furthermore, such exclusion does not solve the problem but simply passes it over to others elsewhere who, uninformed or ignorant, would be unnecessarily exposed. Anthrax spores resist all the ordinary disinfectants. They have been found active after passing through tanning and bleaching solutions. This gives rise to a grave public health menace. Seymour-Jones uses mercuric chlorid, 1:2,500, with 1 per cent. formic acid. Van Schattenfroh suggests forty-eight hours' exposure to 2 per cent. hydrochloric acid with 10 per cent. sodium chlorid. Our laboratory informs us that these measures will destroy spores; but until they are proved by extensive use, they cannot be pronounced absolutely safe.

Anthrax prevention is a matter of cleanliness. Prophylaxis is therefore the keynote of success. Manufacturers should know that the animal product entering into their goods must be cleaned and that the material removed from the hide, hoof or hair (wool) must be sterilized in order to prevent contaminating nearby grounds and, through contamination of insects, as the fly and the mosquito, pass the disease on to man.

Any object coming into contact with the spores may cause the disease. As one writer tersely puts it, "Against an enemy so tenacious and so destructive, the united efforts of all should be directed to prevent its dissemination." We are concerned chiefly with the protection of the industrial worker and the citizen using these manufactured products. The eradication of anthrax involves difficulties that are practically insurmountable. Our efforts must therefore be assiduous and ceaseless. The chief means are education, supervision and regulation. Departments of health can do much and will be greatly aided in their efforts if the public will heed the advice given.

forcing employers to furnish, and workmen to use, these protective devices. Recalcitrants should be heavily disciplined.

Physicians should be on the alert when called to attend any workman whose occupation has to do in any way with animal products, especially animal hair, and whose disease may be anthrax, and should promptly report these cases, as required by law. The earlier the diagnosis, the greater the opportunity for success in saving the life of the patient and the prevention of the dissemination of the disease to others. One fact that is of interest is the failure on the part of physicians to recognize the disease. None of our thirty-four cases were detected by the family physician. The actual condition was not recognized until the patient was removed to a hospital or until the laboratory reported after the patient's death.

OCCURRENCE OF ANTHRAX

Age	Sex*	Date of Occurrence	Source of Infection	Result
79	♂	2/19	Shaving brush.....	Died
20	♂	3/19	Shaving brush.....	Died
57	♂	3/19	Brushes during manufacturing.....	Died
46	♂	4/19	Shaving brush.....	Died
45	♂	7/19	Shaving brush.....	Died
18	♂	8/19	Hair brush.....	Recovered
47	♂	10/19	Shaving brush.....	Recovered
34	♂	11/19	Shaving brush.....	Died
59	♂	11/19	Shaving brush.....	Died
21	♀	11/19	Hair during manufacture of shaving brushes.....	Recovered
24	♂	11/19	Hides.....	Recovered
45	♂	12/19	Shaving brush.....	Died
29	♂	12/19	Hides.....	Recovered
48	♂	12/19	Hides.....	Died
32	♂	1/20	Hides.....	Recovered
48	♂	1/20	Shaving brush.....	Died
68	♂	1/20	Hides.....	Recovered
16	♂	1/20	Table dust brush.....	Recovered
63	♂	2/20	Brush during manufacturing.....	Recovered
31	♂	3/20	Shaving brush.....	Recovered
27	♂	3/20	Shaving brush.....	Recovered
45	♂	3/20	Hides.....	Recovered
18	♂	3/20	Hides.....	Recovered
33	♂	3/20	Shaving brush.....	Recovered
48	♂	4/20	Hides.....	Recovered
36	♀	8/20	Hair cloth and braid during making of hats.....	Recovered
15	♂	6/20	Making brushes from horse hair in school.....	Recovered
24	♂	7/20	Shaving brush.....	Recovered
37	♂	7/20	Shaving brush.....	Recovered
43	♂	8/20	Shaving brush.....	Died
44	♂	8/20	Not determined.....	Recovered
16	♂	8/20	Shaving brush.....	Recovered
14	♂	9/20	Bite of insect ?.....	Recovered
46	♂	9/20	Shaving brush.....	Recovered

RECOMMENDATIONS BY NEW YORK STATE  
DEPARTMENT OF LABOR

The New York State Department of Labor, which handles this matter in New York State, has offered these recommendations regarding anthrax:

(a) Every physician should report every case of anthrax to the state industrial commission.

(b) In every establishment where articles are liable to be infected with anthrax, a competent physician should be employed.

(c) Special provision should be made for the protection of employees.

(d) Every employce should be required to make use of these preventive means. It should be the duty of the foreman to enforce the use of such by employees.

(e) Cooperation with federal, state and municipal officials should be maintained, and all in any way connected with material liable to be contaminated must be made aware of the menace.

RULES FOR EMPLOYEES

Every employee should be informed of the danger of anthrax and the necessity of avoiding infection.

Employees should wear protective clothing and use dressing rooms, wash rooms and lunch rooms according to hygienic rules regarding cleanliness.

No food should be taken into the work rooms and no food taken until the workman has washed up and changed to other clothing.

All slight injuries, as well as severe hurts, should be promptly attended by a physician. The advice of the physician should be followed and the case observed for at least four days, laboratory tests being made early for confirmation.

Every one, employer, employee and the public generally, should cooperate in enforcing the regulations regarding the prevention of this very fatal disease.

GENERAL RULES FOR THE PREVENTION OF ANTHRAX

In factories, warehouses and places where horsehair is handled or stored, the floors should be made of cement or so waterproofed as to be easily washed and kept clean. The walls should be whitewashed. Should a case of anthrax appear, the floor should be cleaned, the scrubbing being done under expert supervision, and the washings sterilized by boiling or burning. The tables, work benches and boxes coming in contact with infected materials should be washed as often as necessary with a disinfecting solution, hot sal soda or hot cresol.

Dressing rooms, wash rooms and lunch rooms should be provided for employees. The dressing room should have individual lockers so that the worker may keep his street clothes separate from this contamination. The overalls should be furnished and washed after use. The wash room should be furnished with hot and cold water, soap, individual towels and individual drinking cups or a small stream fountain.

No food should be allowed in the work room.

RECAPITULATION

Sources of Infection	Died	Recovered	Total
From use of shaving brush.....	9	9	18
From manufacture of shaving brush.....	1	2	3
From using animal hair.....	0	1	1
From handling hides.....	1	7	8
From use of table dusting brush (new).....	0	1	1
From manufacture of women's hats (hair cloth and hair braid).....	0	1	1
From manufacturing hair brushes.....	0	1	1
From unknown cause (mosquito?).....	0	1	1
Aggregate.....	11	23	34

\* In this column, male is indicated by ♂, and female by ♀.  
† As there are no tanneries in New York City, we exclude these from our consideration.

In the industries, especially where animal products are handled, a realization of this menace should be prominent in the minds of the medical and lay staff. The necessity for prompt treatment was never more imperative. In every shop where materials liable to carry infection are handled, the workers should be examined at stated intervals. Every skin disturbance particularly should be promptly reported and examined and, if possible, laboratory confirmation should be secured. Facilities for early diagnosis and early treatment must be provided.

In the prevention of anthrax, nothing is more important than to have the workmen provided with and made to use proper appliances, as gloves, face masks and overalls, which should be cleaned after use. There should be mandatory regulations for the purpose of

Where dust is evolved, special ventilating devices are essential and baffling masks should be worn by the employee. A simple mask which is inexpensive is a thin layer of cotton with one or two layers of cheesecloth on each side, and tapes from each corner of the square mask tied about the neck, one above the ears and the other below. After use, these should be burned.

Publicity given through posters in different languages, with the disease itself pictured, preferably in colors, should be posted throughout all places where these animal products are handled, from the pier to the workshop, warnings of the dangers and methods of avoiding infection as well as the public regulations being made a conspicuous part of this poster.

The employer should be held responsible for the observance of regulations to prevent anthrax in his warehouse or shop.

#### CONCLUSION

Might it not be well to stop the sale or importation of horsehair shaving brushes, and require all brush makers using horsehair to sterilize it before using?

### RELATION OF CONTACT WITH TUBERCLE BACILLUS TO DEVELOPMENT OF TUBERCULOSIS IN ADULTS \*

J. B. ROGERS, M.D.

CINCINNATI

By previous study, I<sup>1</sup> have found that dust containing bed lint collected from the wards, and from window sills and specimen jars from the mortuary where necropsies on tuberculous patients are performed on the average of one every day, contained living tubercle bacilli; also that guinea-pigs placed in sterile cages and kept in the mortuary contracted pulmonary tuberculosis.

The present report of investigation consists of further studies along these lines. These were carried on in order to determine to what extent the tubercle bacilli are scattered around a sanatorium caring for a large number of advanced cases of pulmonary tuberculosis, and to what degree physicians, nurses and other attendants come in contact with the micro-organism. Since this work has been in progress, the researches of Brown, Petroff and Pesquera<sup>2</sup> and of Cumming<sup>3</sup> have given us valuable information on this subject, and the work that I report is in part a repetition of that recently published by these observers. I feel, however, that concerning a subject so important, certain confirmatory observations may not be out of place.

In each of the experiments reported here, the reproduction of the disease in a guinea-pig has been the deciding factor; sixty pigs in all were used. The patients tested were either moderately or far advanced, positive sputum cases of tuberculosis. The objects and conditions studied comprised: droplets from coughing patients; saliva; gauze used by coughing patients to cover the mouth; pillow cases; and the infectiousness of patients' hands, urine and eating utensils, and of magazine covers and door-knobs frequently used by patients.

\* From the Percy Shields Memorial Research Laboratory, Cincinnati Tuberculosis Sanatorium and Department of Bacteriology, University of Cincinnati College of Medicine.

1. Rogers, J. B.: Studies on the Viability of the Tubercle Bacillus, *Am. J. Pub. Health* 10: 345 (April) 1920.

2. Brown, Petroff and Pesquera: Etiological Studies in Tuberculosis, *Am. Rev. Tuberc.* 3: 621 (Dec.) 1919.

3. Cumming, J. G.: Can the Tuberculosis Transmission Rate Be Reduced? *J. A. M. A.* 74: 1072 (April 17) 1920.

#### RESULTS OF EXPERIMENTS

*Droplets from Coughing Patients.*—I held sterile Petri dishes 15 inches from the mouth of patients, who were instructed to cough from twelve to fifteen times. The dishes were then closed, protected from light and carried to the laboratory, where they were washed with 5 c.c. of sterile physiologic sodium chlorid solution, and the entire solution was injected subcutaneously into the left groin of guinea-pigs. For each of the ten patients tested, one guinea-pig was injected, May 1, 1919. Seven pigs, August 6, were found at necropsy to be negative for tuberculosis. September 1, the remaining three pigs, which in the meantime had developed symptoms of the disease, were also found at necropsy to have generalized tuberculosis. March 26, 1920, the experiment was repeated with slight changes. The Petri dishes were held 6 inches from the mouth of four patients, and four pigs were injected intraperitoneally. One pig was killed, May 17, and found to have peritoneal tuberculosis. Two pigs died, May 6, and at necropsy showed tuberculosis of the lungs liver, spleen and peritoneum. One pig was killed, June 26, and found to be entirely negative for tuberculosis.

*Saliva.*—To test the infectiousness of saliva, the saliva from five patients was collected in separate sterile Petri dishes and injected into five pigs, Dec. 31, 1919. Two of these pigs were killed, Feb. 2, 1920, and showed generalized tuberculosis; examination of the remaining three, killed, February 28, showed one to be negative and the other two to have generalized tuberculosis.

*Gauze Used by Patients to Cover the Mouth when Coughing.*—Two pieces of gauze thus used were washed in sterile salt solution and the emulsion injected into two guinea-pigs, one subcutaneously and the other intraperitoneally, April 1, 1920. The subcutaneously injected animal died twelve days later, with the inguinal gland on the injected side in a condition of suppuration. A slide prepared from the pus from the gland showed the presence of tubercle bacilli. The other pig was killed, April 27, and found to have tuberculosis of the mesentery, spleen, liver and bronchial glands.

*Pillow Cases.*—The pillow slips that had been used twenty-four hours by bed patients were washed in sterile salt solution. The wash water was centrifugized and the sediment injected intraperitoneally into four pigs, March 26, 1920, one animal being used for each pillow case. The pigs were killed and examined with these results: April 27, one pig, negative; April 29, one pig, generalized tuberculosis; May 7, one pig, peritoneal and splenic tuberculosis, and May 12, one pig, negative.

*Infectiousness of Patients' Hands.*—Under my direction, five patients were instructed to rinse their hands with sterile salt solution into sterile Petri dishes. One guinea-pig was injected, Jan. 6, 1920, with 10 c.c. of the wash water for each of the five patients. One pig died the following day, another, February 28, and one, March 16, all three being negative for tuberculosis. Necropsies performed on the remaining two, March 6 and March 14, respectively, disclosed generalized tuberculosis.

*Urine.*—In order to test whether or not virulent tubercle bacilli are excreted in the urine in moderately and far advanced cases of tuberculosis, urine was collected in sterile receptacles from ten male patients (all negative for genito-urinary tuberculosis), and 50 c.c. of each specimen centrifugized for thirty minutes at high speed. A small amount of the sediment was then injected into the left groin of a guinea-pig, one pig for each patient, Oct. 18, 1919. Eight of the ten animals were killed, December 30, and examined for tuberculosis, but found to be negative; one, killed, November 25, and one, November 29, also was negative. The experiment was repeated, Dec. 3, 1919, with ten guinea-pigs. Two were killed, December 28; two, Jan. 3, 1920; one, January 8; three, January 15; one, January 22, and one, February 8. These were all uniformly negative for tuberculosis.

*Eating Utensils.*—Spoons that had been used by patients (open cases of tuberculosis) were collected immediately after a meal and washed with 1 per cent. sodium hydroxid. The wash water was then neutralized with half normal hydrochloric acid and centrifugized. The sediment was