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## THE AMERICAN BLOOD TEST FOR CATTLE TUBERCULOSIS.\*

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### I. THE APPEARANCES OF BLOOD IN HEALTHY CATTLE.

OXFORD Co., Maine, is a dairy farm. The inhabitants are pure English blood, indeed purer English than those living in Great Britain.

Intelligent care watches over the kine of Oxford Co., Me. Hence this locality was selected as giving the best standard of kine fed on natural, not artificially prepared foods, living in pastures well watered, with good herbage. The following notes are submitted, of examinations of blood supposed healthy.

#### SERIES I.

Buckfield, Me., kine of Mr. Conant, 1895, July 31. Assistance of Dr. J. F. De Costa now of Rumford Falls, Me., and Mr. Conant.

1. *Stall fed bull.* (a) Crenated red corpuscles. (b) Serum in excess. (c) Crystals of the triple phosphate of ammonia, magnesia and soda. (d) No signs of tuberculosis.

a and b were due to the mode of collecting the blood, punctures not quite deep enough. The extraordinary thick fibrous structure of the bull's skin, with a puncture entirely sufficient for the average human being, merely allowed the serum to filter through with a moiety of the red and white cor-

puscles. It is possible that kine have more sensitive skins than most are aware of, as I have noticed that some kine cringe when approached by unknown persons. In these studies I have sought to modify this bovine fear by having those herdsmen present whom the cattle know.

2. One year old Jersey bull, grass fed. Healthy blood.

3. Cow common breed. Two samples examined. Morphology of healthy blood save triple phosphate crystals in each sample.

4. Cow. Healthy blood.

5. Cow. " "

6. Cow eight years old, normal, some free oil globules and crystals.

7. Cow. Only serum could be had from first specimen. With deeper perforation the second specimen was normal.

8. Cow eleven years old. Normal save crystals and emboli of massive fibrin filaments concreted.

9. Full blood Jersey cow, six years old. Normal save crystals.

10. Cow three years old, (common breed.) Normal.

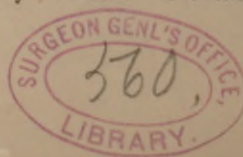
11. Cow seven years old. Normal.

12. Cow ten years old. Normal save crystals.

13. Cow two years old. Normal.

14. Cow three years old. Normal.

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15. Cow seven years old. Full blood Jersey, normal.

SERIES II.

Mr. William Berry's herd. Hebron, Me.

1, 2, 3, 4. Cows common breed. Normal.

5. Cow nine years old. No tuberculosis. Crystals and huddling of red corpuscles. Rheumatism.

6. Cow nine years old. After removing scarificator blood came in drops; unusual thing in kine. Thrombi, crystals, huddling of red corpuscles. Rheumatism, not tuberculous.

7. Cow five years old. Normal.

8. Cow four years old. Normal.

9. Cow four years old. Blood has a tendency to huddle—non-tuberculous.

10. Cow eight years old. Normal.

11. Cow eight years old. Thrombus, crystals, huddling blood. Rheumatism. No tuberculosis.

12. Cow four years old. Serum in excess. Normal.

13. Cow six years old. Blood corpuscles huddle as in rheumatism. Non-tuberculous.

14. Cow ten years old. Blood normal.

15. Cow four years old. Blood normal save crystals.

16. Aug. 7, 1895. Heifer two years old. Some vinegar yeast and crystals, Tuberculous.

17. Cow. Free oil and crystals in blood, no tuberculosis.

18. Cow. Normal blood.

19. Cow. Normal blood.

20. Cow nine years old. Blood contains masses of fat resembling thrombi, otherwise normal.

21. Cow nine years old. Blood normal.

22. Cow eight years old. Blood normal.

23. Cow eight years old. Blood normal.

24. Cow nine years old. Blood normal.

25. Cow nine years old. Blood normal.

26. Cow nine years old. Blood normal.

SERIES III.

Herd of Mr. A. B. Parker, Green, Me., Aug. 5, 1895.

1. One year old heifer. Blood normal save crystals.

2. Cow nine years old. Triple phosphates, crystals, enlarged white blood corpuscles. Thrombi several. Non-tuberculous. Asthmatic three months ago.

3. Cow four years old, thorough bred Jersey; finely normal throughout

4. Cow five years old. Normal blood.

5. Cow four years old. Normal blood.

6. Bull two years old. Normal blood.

SERIES IV.

Hon. Solon Chase's herd of milch kine. Chace's Mills, Me., Aug. 14, 1895.

1, 2, 3, 4, 5, 6, 7, 8, 9. All normal.

10. Normal save crystals and ridged huddled blood. No tubercle.

SERIES V.

Herd of Dana H. & Howard D. Fish, Keene's Mills, Me., Aug. 16, 1895.

1, 2, 3, 4, 5, 6, 7, 8. Normal kine.

9. One single mass of mycoderma aceti or vinegar yeast with massive fibrin filaments, red corpuscles normal. Tuberculous.

Aug. 17. Observation as to No. 9 confirmed. The Messrs. Fish said she had been sick and kept on bad fodder before they bought her.

10. Cow. Rheumatic with triple phosphates, crystals and massive fibrin filaments, otherwise normal.

11. Cow. Normal save oil in blood.

12. Cow twelve years old. Healthy.

13. Cow. Healthy.

14. Cow. Healthy, with some spore collects.

15. Cow. No tubercles, but rheumatism with auto mobile copper

colored spores like crypta syphilitica, common in man, but thus observed in kine for the first time.

16, 17, 18, 19, 20. All healthy.

SERIES VI.

Hon Z. A. Gilbert, Greene, Me., Aug 20, 1895.

Cows 1, 2, 3, 4, 5, 6, 7. Rheumatic.

Cows 9, 10. Healthy as to tuberculosis.

SERIES VII.

Supt. J. H. Conant, Turner, Me., Aug. 20, 1895.

1. Cow. Healthy blood.

SERIES VIII.

Prof. A. H. Bradford, Turner Center, Me., Aug. 22, 1895.

1. Cow. Blood normal.

2. Cow. Probably tuberculous.

3. Cow. Healthy.

4. Cow. Healthy.

5. Cow. Healthy.

SERIES IX.

Herd of F. A. Ricker, Turner Center, Me., Aug. 21, 1895.

1. Cow examined was thought to be tuberculous, but on second examination next day did not appear to be. Spores and spore collects of mycoderma aceti were thought to be due to intestinal fermentation from constipation as in mankind some times.

2, 3, 4, 5, 6, 7, 8. Normal.

SERIES X.

Herd of Mr. Phillips, Turner Center, Me., Aug. 21, 1895.

1, 2, 3, 4, all normal save in 4, masses of blue and green pigment matter were found in the blood, as they are found in the blood of man in connection with fatty degeneration and rheumatism. They were exactly like what is found in the morphology of human blood.

SERIES XI.

Heifer owned and kept by Mr. E. B. Terrell, 165th street and Mott avenue, New York. Fed on hay, grass and grain. Blood proved to be normal. 1895.

SERIES XII.

Herd of F. Homer Foster, B. S., Andover, Mass., Jan. 29, 1891. Morphological blood examination. Query, are they tuberculous?

No. 1. Cow Minnie. Supposed to have tuberculosis. *Red corpuscles* distinct, crenated, segregate, no nummulation. *White corpuscles*; not numerous, much enlarged; nucleus in most.

*Serum.* Fibrin filaments not marked. A few spores.

*Decision.* Behaviour not tuberculous.

*Remarks.* Nov. 7, 1895. This cow found not tuberculous.

No. 2. Heifer Felice. Same as No. 1. Considerable masses of stellurin.

*Remarks.* Same as in No. 1.

No. 3. Cow. Nell of Vale. Same as No. 1 save the presence of large rheumatic fibrin filaments.

*Remarks.* Same as No. 1.

No. 4. Cow Princess. Same as No. 1 save that there were skeins of fibrin filaments.

No. 5. Cow Buttercup. Normal.

No. 6. Cow Bramble. Normal.

No. 7. Cow Clover. Masses of vinegar yeast, mycoderma aceti. Behaviour of red corpuscles normal.

*Remarks.* This cow proved tuberculous.

No. 8. Bull Thesus. Same as No. 1 save the presence of fibrin filaments.

No. 9. Heifer Kate. Normal except fibrin filaments and crystals. Rheumatism.

No. 10. Heifer Melia. Normal.

*Summary.* 116 Kine.

Tuberculosis was found in four cases; rheumatism in twenty-six cases; thrombosis in four cases; signs of fatty degeneration, three cases; blue and green pigments same as in fatty and fibroid degeneration in man, one case. The object of these examinations was to find out how the blood of so-called healthy kine appeared to

one who had studied the morphology of human blood for thirty years. The presence of crystals of stellurine, triple phosphates of lime, magnesia and soda, etc., of rigid, ropy, sticky, red blood corpuscles; of massive fibrin filaments which are found in thrombosis and embolism; of free oil and pigment; was an unexpected surprise. A very interesting, important and practically useful field thus is opened for veterinary exploration and study. Cattle die suddenly of heart diseases; thrombosis; fatty heart, etc.

## II. THE APPEARANCES OF BLOOD IN TUBERCULOUS CATTLE AND TESTS.

*The appearances of blood in kine at Knacker's yard*, condemned to die on account of tuberculosis, by the New York state commission of Veterinary Surgeons.

Present, Dr. Austin Peters, Mass., Dr. Johnson, New York city, Dr. Curtis and by invitation E. Cutter. Greenbush, New York, Dec. 16, 1892.

No. 1. Old bull. Capillary blood from smooth skin beneath the tail, showed spores and spore collects of mycoderma aceti or vinegar yeast. Otherwise normal. Pronounced by me tuberculous.

*Per Contra.* The Veterinary gentlemen noted the post-mortem appearances in all these cases, and to make no mistakes the written results were exchanged with mine some two weeks later.

The following is the Veterinary report: "No. 1. Bull. Tuberculosis of both lungs (extensive) and mediastinal lymphatic glands."

*Remarks.* This is a wonderful report, when it is known that the bull could not be felled by repeated blows of an ax, and with difficulty killed by revolver shots at ranges of about an arm's length. The bull showed a marvellous vitality, which would have stood in good avail, had he been treated for cure. His difficult

death should encourage efforts to cure such cases. Had we such vital resistance in human cases we could make a better showing.

No. 2. Cow. Specimen not well collected, due to the thickness of skin, exposure to cold and raw atmosphere, shrinking from the fear of the kine in their unwonted environments. They acted as if they knew something was wrong. They tried to escape and run away. I have noticed this condition in other cases, the contraction of skin acting like a sieve to restrain the red blood corpuscles and suffer the serum to flow only. Still there were found a few collections of mycoderma aceti and some masses of colloid.

I called the case pretubercular, i. e., where tuberculosis is in the pre-stage, before the lungs are broken down.

"No. 2. Cow. Tuberculosis of both lungs and mediastinal lymphatics, but not so badly diseased as No. 1." Veterinarian report.

"No. 3. Cow. Only a few single spores of mycoderma aceti were found; not a very decisive case, but put down as pretuberculosis possibly."—E. Cutter.

"No. 3. Cow. Found only a pharyngeal abscess, presumably tuberculous."—Veterinarian report.

"No. 4. Cow. A few spore collects. Some massive broken crystals indicating rheumatism."—E. Cutter.

"No. 4. Cow. A very old cow. Tuberculosis in both lungs. Well marked in the right, slight in the left."—Veterinarian report.

"No. 5. Cow. A few segregate individual spores of mycoderma aceti. White corpuscles enlarged. Doubtful. Specimen spoiled by heat of lamp accidentally."—E. Cutter.

"No. 5. Cow you mark doubtful I think her trouble was only bronchitis of left lung."—Veterinarian report.

"No. 6. Cow. A few discrete single spores. Two or three spore collects. Amyloid body(?); crystals. Morphology of blood otherwise normal. Suggests pretuberculous."—E. Cutter.

"No. 6. Cow. Tuberculosis both lungs, but not very extensive."—Veterinarian report.

No. 7. Cow. A very few spore collects, not typical. Otherwise normal. May be pretuberculous.—E. Cutter.

"No. 7. Cow. Tuberculosis both lungs, also a little pus in left fore-quarter of udder."—Veterinarian report.

No. 8. Cow. Red corpuscles normal. White corpuscles enlarged and show entophytal vegetation. Some few spore collects and single spores. Pretubercular I should think.—E. Cutter.

"No. 8. Cow. A few tubercles in both lungs and also in mediastinal lymphatics."—Veterinarian report.

No. 9. Cow. Red corpuscles attempt nummulation. One or two typical spore collects. No fibrin filaments. Enlarged white corpuscles. Some segregate spores. Not a typical case. Pretuberculous.—E. Cutter.

"No. 9. Cow. Had only a very few tuberculous nodules in lungs, but quite large abscess in the udder."—Veterinarian report.

No. 10. Cow. One typical spore collect. Enlarged white corpuscles. Abundant single and double spores, tuberculous. Fibrin filaments not seen. No crowding of red corpuscles. Indeed the behavior of the red corpuscles in all these kine, differs from the behavior of the red corpuscles in man in tuberculosis. Also the fibrin filamentation differs. So far as these cases go, only the spores and spore collects are visible and significant.—E. Cutter.

"No. 10. An old cow, was in life a doubtful case to me, yet on post mor-

tem showed much more tuberculosis than I expected."—Veterinarian report.

"At first study this may not appear so satisfactory to you as it is: All the cases you called "pretubercular" had tuberculous deposits in the lungs, but the satisfactory part comes in when we compare your notes with the extent to which the animals were diseased.

"Your No. 1. The bull you say was decidedly tuberculous, and he was.

"No. 2. Was worse than your notes state.

"No. 3. You say not decisive, and she only had a pharyngeal abscess.

"No. 4. Was not a bad case though well marked.

"No. 5. You call doubtful and so she proved to be on post mortem.

"No. 6. Was not a bad case although well marked.

"Nos. 7 and 8. You call the same, and they were much alike even to roan color.

"No. 9. You say, 'not a typical case;' it was not, there being only a very few small nodules in the lungs, but a large abscess in the udder.

"No. 10. You call 'tuberculous' and she was worse than I expected.

"Your 'pretubercular' cases were not as bad as your tubercular. You are right on the doubtful ones.

"Yours truly,

AUSTIN PETERS.

"Jamaica Plains, Dec. 29, 1892."

CASE II. Heifer pronounced to be badly tuberculous. I could find nothing abnormal, nor did the post mortemists.

There were other cases all like the above. When the great difficulty of the physical exploration of the thoraces of the kine is kept in mind, it is a wonder that there were no more mistakes made.

For example, one old cow who had wheezy breath, did not furnish any

sign of tuberculosis by blood examination, and after death her lesion was proved to be a contracted trachea from traumatism.

The writer acknowledges his indebtedness to the kindness of the veterinary surgeons, and thanks them for their courtesies.

### III. COMPARISON WITH TUBERCULOUS BLOOD IN MANKIND.

#### a. *Morphology of the Blood in Health in Man.\* After Salisbury.*

*Blood from Capillaries.* Color; bright, fresh, clear, ruddy, strong. Clotting rapid and firm. *Red Corpuscles* arrange themselves in nummulations, or are scattered evenly over the field. Normal in size. Non-adhesive. Central depression well marked on both sides; periphery well rounded, clean cut. Hold coloring matter firmly. Pass readily to and fro through the fibrin filaments. Appear fresh and fair, giving an appearance of health, like a rosy cheeked maiden full of life. *White Corpuscles* normal in size. Not enlarged by internal collections of foreign bodies. Amoeboid movements strong or not. Proportion one to three hundred of red corpuscles. Consistence good. Not sticky. Color a clean white. Freely moving at will. *Serum* clear and free at first sight from any form. After five minutes, most delicate semi-transparent fibrin filaments appear, forming a very light network in the field, which offers no obstacle to the passage of the corpuscles. There should be no spores or vegetation in healthy serum, though they may be found by very minute examination, or by letting the blood stand for several days in closely stopped phials at a temperature of from 60 to 75° Fahrenheit. This is not saying that spores and filaments

\*The Clinical Morphologies of the Blood, Sputum, Fæces, Urine, Skin, Vomitus, Foods, (Including Potable Waters, Ice and Air) the Clothing and Soils. Ephraim Cutter, M. D.

cannot be found in blood of persons calling themselves healthy—for some diseases exist in a latent condition, like rheumatism, syphilis, cystinæmia and consumption. I have met with people who, on finding vegetations in their blood, have decided not to accept the evidence because they deemed themselves healthy. Again it is difficult to find a perfectly healthy person in the community; this was made public during the "late unpleasantness," when drafts were made for soldiers. The blood evidences must be taken in connection with that of the other physical signs. *The morphology of healthy blood is a most rigid test, and in delicacy and far reaching goes beyond any of the other physical signs.*

#### b. *Morphology of the Blood in Consumption of the Lungs.\* After Salisbury.*

*Use.* In diagnosis, exceeding in value auscultation and percussion, because it detects consumption of the lungs before there is any lesion of them. To show the real progress of the case by the substitution of the morphology of health more or less, to show when the patients have lapsed in the treatment by eating forbidden food, and to show when there is a real cure. To repeat, most valuable of all to make a diagnosis of consumption with as much certainty as it is possible in human affairs, and by removing the uncertainty, sometimes dreadful, of the diagnosis that accompanies the conventional first stages of consumption of the lungs.

"This value is so great that it is more than a warrant for this publication to be made. It is hardly possible to overestimate the importance of this department of physical exploration.

\*The Clinical Morphologies of the Blood, Sputum, Fæces, Urine, Skin, Vomitus, Foods, (Including Potable Waters, Ice and Air) the Clothing and Soils. Ephraim Cutter, M. D.

"*First or Incubative Stage.* Red blood corpuscles are less in number, rosy, and sticky, more or less, but not much changed otherwise.

"*Second Stage of Transmission.* 1. *Red Corpuscles.* Color, pale, non-lustrous; not clear cut, not ruddy. Consistence, sticky, adhesive. Coating of neurine removed. Not so numerous as in normal blood. Owing to the increased size and strength of the fibrin and the stickiness, they form in ridges, rows, but not so marked as in rheumatic blood. They accumulate in aggregations of confused masses, like droves of frightened sheep. They adhere to each other, and are rotten, as it were, in texture. 2. *White corpuscles.* Enlarged and extended by the mycoderma aceti or spores of vinegar yeast, that are transmitted into the blood stream from the intestines. 3. *Serum.* More or less filled with the spores of mycoderma aceti or vinegar yeast. These occur either singly or in masses of spores, which is the common form in which they are found, wherever vinegar is produced. *The fibrin filaments* are larger, stronger, more massive than in health, and form under the microscope a thick network which is larger, stronger and more marked in direct proportion to the severity of the disease or the amount of accumulation. Besides, the serum is apt to be of a dirty ash color. The sticky white corpuscles, the massive fibrin filaments in skeins, and the yeast spores alone or combined, form aggregations, masses, collects, thrombi, and emboli which block up the blood vessels of the lungs soonest, because exposed to cold air, the most of any viscus; *the blood vessels contract, and thus arrest the thrombi and form a heterologous deposit, which is called tubercle.*

"*The Third Stage, or Stage of Tubercular Deposit.* These deposits increase so long as vitality subsists

in the tubercle and surroundings. When the vitality ceases, the tubercle softens or breaks down. Sometimes if the process is very slow, and life slightly inheres in it, the proximate tissues undergo fatty infiltration, which preserves it from readily breaking down. The morphology of the blood is the same for the second and third stages of consumption.

"*Fourth Stage. Interstitial Death.* Morphology of the blood in this stage is the same as in the second and third, save that it becomes more impoverished. *The Red Corpuscles* are thinner, paler, much lessened in number, increased in adhesiveness, stickiness and poverty. Devoid more or less of neurine. *The white corpuscles* are fewer in number, more enlarged; often ragged and rough. Distended with spores of mycoderma aceti, more adhesive and sticky. *The serum.* Fibrin filaments are thickened, stronger, more massive and more skeins of them present. The collects of mycoderma aceti are very much larger and more numerous; in moribund cases, I have seen them so large as almost to fill the field of the microscope. They present anfractuous edges and amœboid prolongations, giving them a weird, bizarre aspect which, under the circumstances have a portentous aspect, for the larger and more numerous the spore collects of mycoderma aceti are, the *more dangerous the case.*"

#### c. *Comparison of Kine Blood and Human Blood.*

1. The morphology of *normal blood* of kine exactly corresponds with that of man as given above.

2. The morphology of *tuberculous blood* in kine is not the same as in man so far as *these observations go, Differences as follows:* (a) Red corpuscles act normally. (b) Fibrin filaments are not massive and numerous.

*Similarities of kine tuberculous blood to that of man.* (a) White corpuscles enlarged often more than in man. (b) The mycoderma aceti or vinegar yeast is present as in man.

Indeed it was on this yeast that I made the diagnoses which were better than the average prognostications. As noted, it occurs as single, double and multiple spores; in large snow white masses of fusiform shape, sometimes in large abundance just as in man. They are unmistakable, positive. Have been found reliable evidence for many years.

#### IV. ADVANTAGES OF THIS BLOOD MORPHOLOGICAL TEST OVER TUBERCULIN.

1. It is simple, readily learned, easily applied.
2. It introduces no diseased matter into the blood to set up efforts to expel diseased tissues (not to stop causes), which efforts of expulsion cause fever.
3. It allows the diagnosis of the pretubercular stage and the cure of the cattle; tuberculin is of no value except when there is actual disease and breaking down of the lungs.
4. It does not involve the loss of the kine.
5. It is always good so long as pre-tuberculosis or tuberculosis exists; and as in man, is of immense value in making negative diagnoses when neither tuberculosis nor pre-tuberculosis exist.
6. The amount of the yeast spores present is a sort of measure of the amount of the lesion; the more the disease the more the yeast.
7. It can be applied often and harmlessly.
8. It is common sense in principle, as it treats of causes, while tuberculin treats only with results, influencing causes not one particle.

9. Even if time shows that the writer has overestimated the value of this test, it is the best means of detecting tuberculosis and pre-tuberculosis in man and kine.

#### V. IMPORTANCE OF SUBJECT.

It is of importance to have healthy kine, but we do not believe all the sensational reports as to the communication of tuberculosis to man from cows, for if true we should almost all be dead. The evidence is overwhelming that tuberculosis comes from food, in excess and long continued, which either before or after ingestion undergoes the *acetic acid fermentation*. It is not the place here to enter into this, but it may suffice to say that food of kine or man undergoing the alcoholic and vinegary fermentation is most favorable for tubercle. The ordinary silo seems to be the most favorable method to obtain such food. The fact that tuberculosis in cows is most prevalent where ensilage, brewers' grains and forced feeding are used; the fact that bovine tuberculosis has only come into prominence since such feeds have been used; the facts that alcoholic and vinegary yeast are found in abundance in silo food, and are found in the blood of tuberculous kine; the fact that hogs kept on distillery swill contracted tuberculosis, all these show that the farmer must take other views than those that now obtain. The farmer to-day is like the man in Pilgrim's Progress, pouring water on a fire which will not go out because some one behind him is pouring on oil; killing tuberculous cattle and feeding the newly bought kine with sour foods will not extinguish tuberculosis from his herd. In conclusion, I wish to thank the veterinarians and all who have made these studies possible.

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