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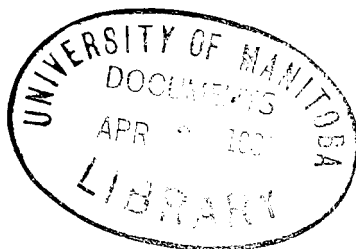
Agricultural College of Colorado.

RELATION OF BOVINE TO HUMAN TUBERCULOSIS.

G. H. GLOVER.

TUBERCULIN TESTS OF THE COLLEGE HERD.

B. C. BUFFUM.



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The Colorado Experiment Station.

PLATE I. KATE—JERSEY COW, APPARENTLY HEALTHY, BUT BADLY DISEASED WITH TUBERCULOSIS.

PART I.

REVIEW OF THE ARGUMENTS OF THE RELATION OF BOVINE TO HUMAN TUBERCULOSIS.

BY GEORGE H. GLOVER.

The recent test of the College herd with tuberculin and the consequent discovery of tuberculosis among cattle which were supposed to be in perfect health has led to some controversy; on the one hand by those who, because of their knowledge gained by actual observations and experiments, and who having been trained to think and reason to logical conclusions, are warranted in expressing themselves; and on the other hand by those who are not so warranted.

One thing in particular, more than any other, has inspired the issuing of this bulletin, viz: The evidence everywhere extant, that since the stand recently taken by Dr. Koch, there has settled upon the public a determined disposition to belittle the whole matter and throw precautionary measures to the wind. We urge upon all the warning that the difference between human and bovine tuberculosis has not yet been settled finally, and that precautionary measures for preventing the spread of the disease by butter and milk cannot be safely abandoned. It is one of the misfortunes accompanying the deliverance of such an uncompromising thesis as that by Dr. Koch that obscurantists of every dye make it responsible for conclusions which are not warranted by the facts in the case. It cannot be too strongly emphasized that even if it be proven that bovine tuberculosis is not communicable to the human race, the necessity for the most scrupulous cleanliness in the management of cows and their milk production is as great as ever. This incident coupled with the perfectly reliable information which we possess that a large percentage of the dairy cows in Colorado supplying milk to our towns and cities (especially the latter) are consumptive, and that it is yet far from proven that this disease is not communicable to human beings by the use of such milk; and further, lest the recent stand taken by Dr. Koch results in a criminal laxity or indifference: have together inspired the issuing of this bulletin. It is not claimed that we have made any new or startling discoveries: the work among the College herd, so far as it has gone, has in every instance corroborated our claims

(and which are in harmony with a great majority of the foremost investigators in this line of research) and the conclusions arrived at by reliable authorities are here compiled in as brief a manner as possible, hoping to accomplish something toward arousing the masses from their lethargy relative to the importance of this serious condition as affecting the animal wealth and the possibility of its being a prolific source of disease in the human family.

In the annual report of the Veterinary Science Department of the College, the assertion is ventured that the public in general in judging of veterinary science is prone to look upon it from a purely commercial (and in a lesser degree humanitarian) standpoint and do not take cognizance of its broader sphere of usefulness, viz: what the science is doing for the health and lives of the people themselves. It is in keeping with this thought that we venture a step further and assert that the educated veterinarians are among the leaders in the van now vigorously prosecuting the research that is being made in regard to the relation of human to bovine tuberculosis.

Tubercular consumption is one of the most dreadful and unfortunately, most common diseases of mankind. People of all ages or circumstances, and environments, regardless of climate, nationality, or degree of civilization, are subject to infection, if exposed under proper conditions. None are immune, and the present conditions prevailing, it looks as if we are doomed to become a sickly, consumptive race, and that its ravages must eventually almost wipe the human race from the face of the earth.

The greatest good to humanity will be accomplished along the line of preventing disease and while the prevailing medical thought now, both human and veterinary, is absorbed in new remedies, and is alive with keen expectancy as to the possibilities of sero-therapy, (which seems almost beyond conjecture) yet, after all, we must admit that prophylaxy (prevention of disease) is of vastly more importance than the discovery of new cures.

NOT A NEW DISEASE.

History from the earliest times has been replete with accounts of this "great white plague" and the theories advanced to account for its etiology and pathology have only been equalled in variety by the persistency with which they have gone wide of the mark.

At one period it would be considered contagious, at another this would be thought improbable, again several of the local manifestations of this disease would be looked upon as separate and distinct diseases; at other times it has been confounded with diseases that had no relation to it whatever. It seems strange, but it is nevertheless true, that while this disease has been known as affecting the lower animals, and a scourge in man (now claiming ten per cent. of the death rate) during all these centuries comparatively nothing was accomplished in working out its etiology or pathology until within the last fifty years Villimian and Koch have placed the matter on a sound basis.

IS A GERM DISEASE.

Long before any suspicion existed as to the relation of bacteria to fermentation and disease, various scientists, at different times, had suggested that resemblance existed between the phenomena of certain diseases and fermentation, but the idea that a virus or contagium might be something of the nature of a minute organism, capable of spreading and reproducing itself, had never been thought of. The first vague notion in this direction was no doubt the ferment theory of Cagniard-Latour in 1828. In 1837, Schwann showed that fermentation and putrefaction were intimately associated with the presence of organisms derived from the air. By 1862 Pasteur had buried forever that "will-o-the-wisp" spontaneous generation and repeated and extended such experiments and proved the way for a complete explanation of the anomalies.

From 1870 onward the "germ theory of disease" had passed into general acceptance and now has become an assured fact, and in a sense has revolutionized the theories of disease and treatment in that now a persistent war is waged on the micro-organisms which excite the disease, and is not based altogether upon symptomology. Robert Koch first succeeded in demonstrating and isolating the specific bacillus of tuberculosis and achieved its artificial cultivation the use of blood-serum.

TRANSMISSIBILITY.

The origin of the germ theory of disease and the discovery of the specific bacillus of tuberculosis are but parts of an old story now relegated to history, but when we

look up the subject of the transmission of these germs from one animal to another, including man, we are at first surprised and then astounded at the seriousness of the conditions actually existing, and the grave possibilities which the tireless investigation by scientists may yet have in store for us.

NOT CURABLE.

Favorable climatic influence will often stay the progress of the disease for a time at least, but no climate or therapeutical agent has ever been discovered which can in the true sense be called a cure. If ever anything is accomplished in either curing or preventing the disease it will most likely be in the direction of sero-therapeutics, but this is conjectural to say the least.

RELATION OF BOVINE TO HUMAN TUBERCULOSIS.

That tuberculosis is transmitted from one animal to another, and more especially from the cow to other domesticated animals, has been repeatedly proven so that it is considered a waste of time now to rehearse them. The whole subject is summarized by Dr. John Repp in an article read before the Iowa Tuberculosis Convention in this way: "Enough has been done to prove beyond the peradventure of a doubt, that tuberculosis may be transmitted through the milk and the food structures of tuberculous animals, to the animals that consume these products or are inoculated with them, upon this all students of the subject agree. This much has been proven, but these facts do not decide the important question at issue, viz: whether or not tuberculosis is transmitted from animal to man, nor would they if they were multiplied ad inñitum, they only furnish a basis from which we may reason, for this purpose they are invaluable, as they establish the premise that the meat and milk of animals do, at times, contain living virulent tubercle-bacille."

If some of the incredulous will show the faith of their convictions by submitting themselves to a few "hypoës" of bovine bacillus-tuberculosis, or by voluntarily injecting a few of the same, it will supply the last link in the chain of evidence necessary to convict the cow of transmitting the disease through her milk and meat to her human benefactors.

As there is little probability of anyone offering in good faith to sacrifice themselves for the cause of science, let facts

be submitted which, while circumstantial, are sufficient to lead us beyond the range of probability, to the very verge of absolute certainty. Our certain knowledge on the following may be analyzed as follows:

TRANSMISSION OF TUBERCULOSIS FROM ONE ANIMAL TO ANOTHER NOT INCLUDING MAN.

1st, by Meat.—Experiments, by their positive results, demonstrate that tuberculosis is transmitted in this way, both by artificial inoculation with the muscle juice of tuberculous animals, as well as by feeding the diseased tissue.

2d, by Milk.—This has been as fully demonstrated by a long series of experiments consisting of the inoculating of different animals with tuberculous milk, both from cows with diseased udders as well as those not so diseased, and further by the feeding of calves, rabbits, pigs, etc., with milk from tuberculous cows.

TRANSMISSION TO MAN.

There is, as previously stated, for reasons well understood, no opportunity to secure evidence by artificial methods. By natural methods the evidence consists of recorded observations, which have been made by close observers, covering a period of many years, of people who have used the milk and meat of tuberculous cattle. Dr. John Repp has gathered some statistics bearing on this point which are most interesting, as follows: "Oliver reports that in a young ladies boarding school, five girls, the children of healthy parents, died of tuberculosis of the intestines. The cow which had for many years supplied the school with milk was found to have generalized tuberculosis including the udder.

"Two daughters of a Scotch family of good health, who were brought up on milk of tuberculosis cows, died of tuberculosis. Two sons in the same family, who did not use the milk remained healthy." "Stang reports the case of a five-year-old boy of sound parentage and ancestry, who died of tuberculosis. The cow whose milk this boy used was found badly tuberculous." "Demme reports the case of four infants in the Children's Hospital at Berne, the offspring of sound parents, that died of intestinal and mesenteric tuberculosis. He was able to exclude all other sources of infection and to decide that they had been infected by

the ingestion of the milk of tuberculous cows." "Hills mentions the case of a child twenty-one months old of a friend of his, which drank the milk of a highly tuberculous cow for one week while on a visit to his uncle, and three months later this child died of intestinal tuberculosis. Other sources of infection could be excluded. A second child brought up on sterilized milk is still healthy." "Hills also reports the death of a boy four years old, at Yonkers, New York, from tubercular meningitis. The infection was traced to the milk of two cows of whose milk the boy had drank and which proved on autopsy to be tuberculous." "Ernest reports the death of three children of one family, from tuberculosis. These children had used the milk of a cow which later died of advanced tuberculosis including the udder.

"Stalker and Niles report that five persons, between twenty and thirty years of age of healthy ancestry, died of tuberculosis within a period of two years. On the farm where these deaths occurred they found seventeen cattle suffering from tuberculosis, and other cattle had previously died of this disease.

"Leonhardt reports the death from tuberculosis of the meninges, intestines and mesentary, of two children fed on the milk of a tuberculous cow. Sontag reports the case of a six-months-old child of healthy parents, which died of tuberculosis and which had been fed on the milk of a tuberculous cow. Hermsdorf has reported the case of a child, dead of intestinal tuberculosis, which had been fed on the milk of a tuberculous cow. Rich reports that a young man of healthy parents, who died of tuberculosis, had used plentifully of the milk of a herd of seventy-four cattle, sixty-five of which were tuberculous, some of them markedly so. Also another young man of the same family died of tuberculosis two months later. Rich destroyed eighty cattle out of the herd, that is about 90 per cent, of the entire herd. Also a young woman died of tuberculosis, and a month later the cows, whose milk she had used, died of advanced tuberculosis."

"Thorn reports that twenty-two physicians out of 339 practicing in Ohio, replied in the affirmative to the question, 'have you been able to trace any cases of tuberculous disease to the milk of unhealthy cows?' and that thirty-three replied in the affirmative to the question, 'Have you had reason to suspect the origin of tubercular disease in older children or adults to be in the meat or milk supply?'

This series of experiments and observations has been selected from literature with the greatest care, any reports which appeared not to be well authenticated or of a doubtful nature being excluded."

"Further circumstantial evidence is at hand in the fact that such large numbers of the bottle fed children die of the abdominal form of tuberculosis, and while, in some countries, the death rate of adults shows a marked decrease, the tuberculosis of children, and especially infants, is on the increase."

As previously stated, if we could but supply the one missing link, viz: whether the bacillus of tuberculosis is pathogenic for man, we would have our chain of evidence complete, and a positive demonstration would be our reward and the question would be no longer doubtful. The cases which I will now quote, from Dr. Repps' report, show conclusively that tuberculosis in the bovine species can be conveyed to man through one channel at least. "Tscherming, of Copenhagen, attended a veterinarian who had cut his finger in making a post-mortem on a tuberculous cow. The wound healed but there still remained a swelling which soon ulcerated and refused to heal so that the whole tumefied mass had to be cut out. The microscope revealed the distinct tuberculous process and the presence of the characteristically staining bacilli." Pfeiffer attended at Weimar, a veterinarian named Moses, thirty-four years old, of good constitution and without hereditary disposition, who, in 1885, cut his right thumb deeply in making a post-mortem on a tuberculous cow. The wound healed, but six months later the cicatrix still remained swollen and in autumn, 1886, the man had pulmonary tuberculosis with bacilli in his sputa and death occurred in two and one-half years after the wound. Post-mortem revealed tuberculosis of the joint of the wounded thumb, and in the lungs extensive tubercles and vomicae." "Law reports that a young veterinary friend of his who was inoculated in the hand in opening a tuberculous cow, suffered from a tumefaction of the resulting cicatrix with tubercle-bacilli."

Rich reports that a man cut his finger on a spicule of bone, while making a post-mortem examination of tuberculous cows, and that in a few weeks he developed a tuberculous joint, and a few months later showed unmistakable signs of phthisis.

Ravenel reports the case of a veterinarian who cut the knuckle of his finger while making post-mortem examina-

tion of a tuberculous cow. The wound healed badly, remained swollen and showed decided tendency to ulcerate. Removal of cicatricial mass was practiced the tissues sent to him for examination. They showed typical tubercular lesions with giant-cell formation.

"I am well acquainted with this case myself and believe it to be an undoubted case of direct transmission of tuberculosis from cow to man by inoculation. This veterinarian told me that he did not become alarmed about the wound on his finger until he noticed a swelling and tenderness of the lymphatic glands on the muscle of the elbow."

The statistics gathered on this point are not many, but are exceedingly valuable as far as they go.

BOVINE TUBERCLE MORE VIRULENT THAN THE HUMAN VARIETY.

From the scattered records of inoculation experiments, both early and recent, relative to the degree of virulency of of the tubercle bacilli of man and the bovine species, the conclusion arrived at I can best express by the following quotation: "To sum up the matter in a few words, it may be said that bovine tubercle has been shown to be more virulent than the human variety for cattle, sheep, goats and rabbits, while no distinction has been shown in the case of horses, pigs, cats and dogs.

DOMESTIC COW THE NATURAL HARBINGER OF THE BACILLUS TUBERCULOSIS.

Dr. G. A. Johnson, in an article read before the Sioux Valley Medical Association, takes the position that in the bovine species we have the natural hosts of the bacillus tuberculosis. His argument is so fair and altogether unique that while it is entirely foreign to the prevailing idea of the medical fraternity, it is certainly worthy of serious consideration. He states his proposition in this way. "Tubercular lesions, wherever found, are the direct results of the action of the tubercular bacillus; and further, that the domestic cow is the natural harbinger of this bacillus; or in other words, tuberculosis was primarily a disease of the bovine species and is found in man and other animals as a result of transmission brought about through the ability of the tubercular bacillus to adapt itself to the various conditions as found in the various animals.

He reasons from analogy that a careful study of the geographical distribution of tuberculosis reveals the fact that all people who use the milk and flesh of the domestic cow (the *and* inbred cow) as food products are more or less afflicted with tuberculosis, and further, that there is usually a very uniform ratio between the quantities of such foods consumed and the prevalence of the disease among the people.

On the other hand all of those people who do not use the food products of the domestic cow are comparatively free from the disease.

Prof. E. F. Brush, M. D., of Mount Vernon, N. Y., states as follows: "This insidious and delusive disease is not the result of civilization as is supposed. Barbarous and semi-civilized races are afflicted as severely as many of the most advanced civilized races." Neither geographical position nor climatic conditions are a factor in the distribution of pulmonary phthisis. Every known part of the globe, with a few isolated areas excluded, is a habitat of the disease. After several years of close study of the affection and consulting all accessible statistics and the habits of the people where the disease prevails, the only constantly associated factor is found, in my opinion, in the inbred bovine species without any regard to the social position of a community or its geographical habitation, terrestrial or atmospheric condition. If a community is closely associated with inbred cattle, tuberculosis is prevalent. In the fifteenth annual report of the State Board of health of New York, is found the following: "Human tuberculosis is co-extensive with bovine tuberculosis. Broad generalization of our laws and knowledge gives a close parallelism between the numbers of dairy cows and the prevalence of tuberculosis in the human race. Countries that have few or no cattle, or in which the herds are mainly kept in the open air, and are therefore largely protected from the disease show, as a rule, little tuberculosis in man."

Dr. G. A. Johnson, in substantiation of his argument, has found the conditions prevailing in different countries relative to this matter as follows:

Europe—Cattle have existed and tuberculosis has prevailed in man for centuries.

Australia—Tuberculosis was so rarely seen in early days as to lead to the idea that the climate was incompatible with the disease, but with the advent of cattle raising con-

sumption appeared among the people and has been gradually increasing.

New Zealand—Among the native Maories phthisis was unknown previous to the settlement of the English, and they possessed no cattle, but since that time tuberculosis has become a veritable scourge. Hirsch has said, "In my opinion the death rate from phthisis will keep on increasing in that locality if the breeding of cattle is not properly regulated by law."

South Africa—The coast tribes of Africa have been inbreeding cattle for centuries, and the natives have been tuberculous, while the tribes in the interior have had no cattle, because of the Tsetse fly which stings and kills them, have always been free from consumption.

Madagascar—The flesh and milk of cattle has been the principle diet of the native and they have been severely afflicted.

North American Indians—The native American Indians were always free from consumption until Uncle Sam began dealing out meat and cattle to them. Their habit of eating any and all parts of the carcass, often without cooking, has aggravated the conditions for the most favorable transmission of the disease and they have become consumptive.

The Esquimaux—Dr. Johnson has well expressed it when he says, "The Esquimaux has his dogs and reindeer, but no tuberculosis, while the Indian has his dogs and beef and is seriously afflicted with tuberculosis." On the other hand, it is found that the Indian is no more susceptible to the disease than is the Esquimaux, for when the latter is brought in contact with the white man and his cow he readily contracts the disease, etc.

Italy—The people are tuberculous, notwithstanding they have one of the balmiest climates of the earth.

China—Notwithstanding their dense population, consumption is rare, because the lower classes, which constitute the mass of the population, get very little or no meat or milk. And so he goes on with a review of the different people of various countries and islands of the globe, showing in each and every instance that those people who use the milk or meat of cattle are consumptive and just in proportion as they use said products and those who do not possess cattle at all are entirely free from it.

Climate—Immunity does not exist in any climate, or among any race of people. And while high and dry

climates like Colorado are beneficial in staying the progress of the disease, yet it prevails in various sections from the torrid to the frigid zones.

Altitude—Altitude has nothing to do with the distribution of the disease, for we find it from the sea coast to the regions of the highest mountains. Dr. Johnson says that "certain peoples inhabiting the Dead Sea basin, which is between 100 and 200 feet below the sea level, are free from tuberculosis, whereas it is more or less prevalent among most people inhabiting the mountainous regions of Europe and America."

Civilization—The disease does not follow in the wake of civilization, for some of the savages and semi-civilized races are seriously afflicted.

Density of Population—As previously indicated, China and India, two of the most densely populated countries, are comparatively free from tuberculosis, and in many of the rural districts of Europe and America the disease prevails.

Filth and Poor Sanitation—This has nothing to do with the distribution of the disease for we find it all the way from the wigwam to the palace. The fact remains that all these various conditions simply hasten to retard the morbid process, and not one of them can be said to be a constant factor in the distribution of the disease. The old argument of heredity has long ago fallen to the ground and been trampled to the dust, for new cases of consumption are constantly coming to view, where there cannot be traced any hereditary taint.

The only constant factor seems to be the milk and meat of the bovine species, and we certainly consider this argument worthy of serious consideration.

CONCLUSIONS.

1. The position taken by Dr. Koch is of inestimable value, whether right or wrong, as there has been nothing new but this conclusion placed before the medical and veterinary profession during the past decade, and it has aroused everybody from their lethargy and encouraged discussion and experiment as never before.

2. It is unwarrantable to assume that, because of the low virulence of human bacilli for cattle, that the reverse is true. It has been repeatedly shown that bovine bacilli are more virulent than the human. Bovine bacilli being easily transmitted to rabbit, horse, dog, pig and sheep, and in short, to almost every quadruped on which they have been tried, makes it highly improbable that man is not included in the list; and until this is disproven by actual experiment upon the human, it will not be wise to relax prophylactic measures.

3. Dr. Koch has been grossly misrepresented since his London Congress address. He says, among other things, 'I have one word and only one word to say, and that is what I said in London. That word is 'experiment!'" I would send it to my brother practitioners the world over. The time is past when we may be guided with either certainty or profit by statistics. Nothing short of actual dealing with actual conditions will avail. We demonstrated that human tuberculosis was incapable of transmission to cattle. We have now to lend ourselves to the reverse proposition.

"I did not mean to recommend the abandonment of comprehensive and expensive systems of regulation, prevention and inspection that is now in operation.

"We are well on the road to victory over consumption. The final triumph is denied only by those who are unwilling to sacrifice their hobbies and work together to the common end."

PART II.

TUBERCULIN TESTS OF THE COLLEGE HERD.

BY B. C. BUFFUM.

Our investigation of tuberculosis among the cattle belonging to the College is in line with what has been done by other Experiment Stations of prominence which have been doing live stock work. There is nothing startling or new, perhaps, in our findings, but we feel the matter is of much importance to the public. Dealing as it does, directly with our animal wealth and indirectly, perhaps, with the public health, it is well for the Station to give to the people of the state such information as we possess. We are not indulging in personal opinions or theories, but will confine our statements to what we believe are established facts. We believe it is high time that our agricultural communities should accept the situation, and dispassionately and intelligently take such wise action as will advance their own interests and, in all probability, alleviate human suffering as well.

So much has already been done to prevent and partially cure tuberculosis, that there is no longer excuse for allowing the disease unchecked progress either among animals or men. Tubercular consumption is now known to be a preventable disease and, contrary to the general opinion, it has been demonstrated that it is curable in a large per cent of cases or, at least, that the course of the disease may be checked for many years if taken in time and properly managed. It is probably true that there are over ten million people now living in the United States who are doomed to die of this dread disease unless something is speedily done to reduce the present death rate. This may be considered a fair statement of the present status and prevalence of human tuberculosis.

Cattle seem to be more subject to tuberculosis than any other representatives of the animal kingdom, but it is hardly possible to arrive at a correct estimate of the money loss to our agricultural interests from the bacillus tuberculosis. Coupled with these two items is the supposed relation of human and bovine tuberculosis. The disease in man

and in cattle has long been considered identical and in view of the many facts supporting such belief so well presented by Dr. Glover in Part I. of this Bulletin, it is well that everyone should understand the possible danger and take such precautions as will save money loss with stock, and protect against personal contagion. It is reported that Dr. Koch, before the London conference on tuberculosis, expressed the opinion that human and bovine tuberculosis are not due to the same germ. If reports are true, Dr. Koch believes that there is proof that human tuberculosis cannot be transmitted to cattle and, while not demonstrated, he thinks bovine consumption not transmissible to man. Dr. Koch discovered the true cause of tuberculosis and fully demonstrated the germ nature of the disease. He is one of the world's greatest authorities and his opinion should be given much weight. However, scientists are often misquoted and a simple statement of a failure to produce certain expected results in an experiment is twisted into a quotation from an authority, that it is an impossibility to produce the results. Newspaper misquoting and reportorial enlargement of scientists' statements are often mistaken for true science. It opens the way for ridicule and prejudice and does much to retard the acceptance of scientific facts. If Dr. Koch failed to transmit tuberculosis from man to cattle, or if he has discovered differences in the germs from animals and men which led him to doubt the identity of the two forms of the disease, it does not necessarily follow that the expression of this doubt is a statement of fact that there is one form of the disease in cattle and another in man and that they are never transmissible from one to the other. Dr. Koch thought that his lymph or tuberculin was a cure for tuberculosis. It was a wonderful discovery and a most important one, but because it failed to cure human tuberculosis is no reason for rejecting the careful scientific work of the man. The principle of using the toxin or poison produced by a germ to destroy the germ, or its power to live in the system, was established by Jenner when he introduced vaccination against small pox and is successfully used as a cure of the disease in diphtheria. One of our state papers (*The Eastonville World*) takes a sensible view of the present statements of Koch, that he doubts the general infection of man with bovine tuberculosis, and points out the fact that we need not plunge into the use of unsanitary milk, butter and beef because a scientist has expressed such a doubt. Before

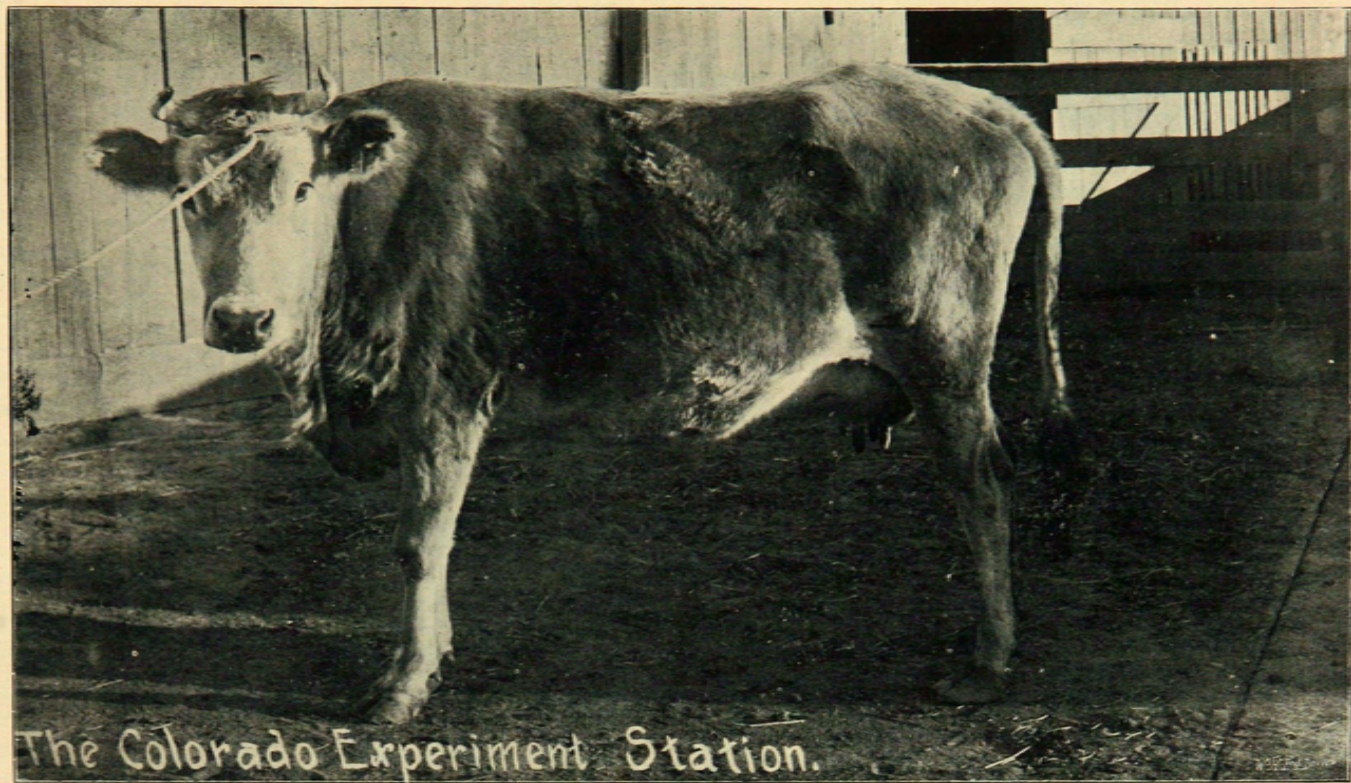


PLATE II. COUNTESS LEE—JERSEY COW WITH GENERALIZED TUBERCULOSIS.

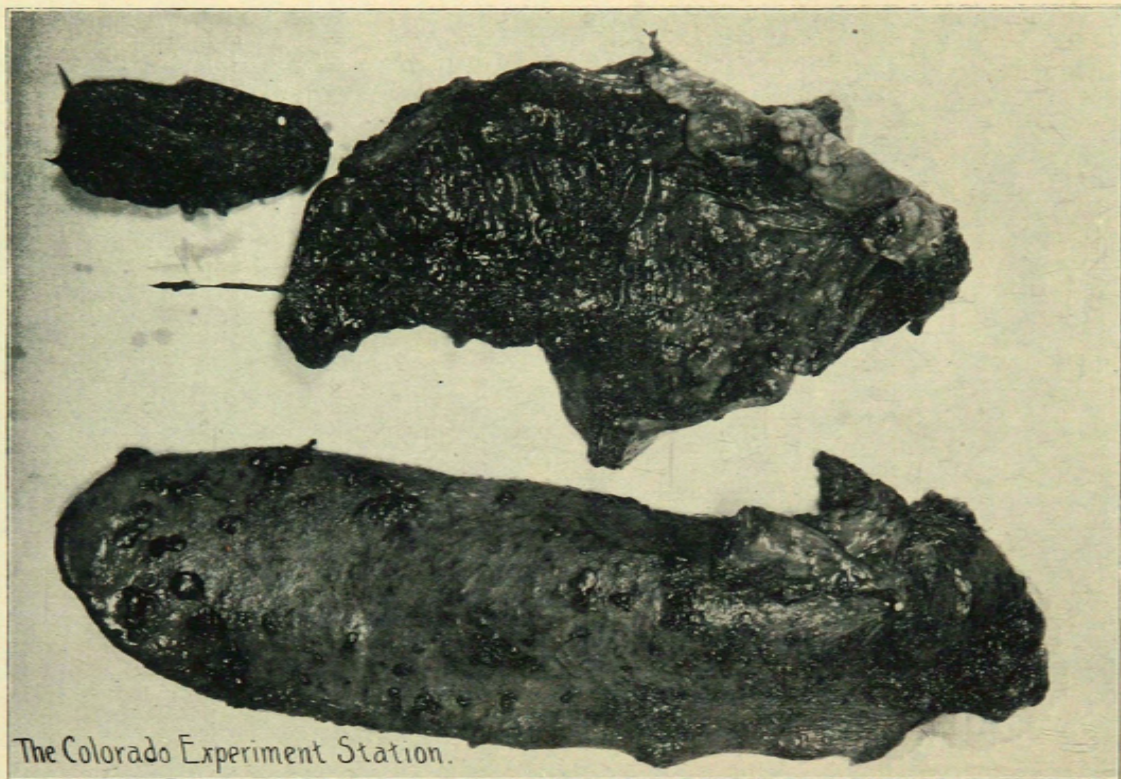


PLATE III. SECTION OF LEFT LUNG OF DISEASED COW FILLED WITH TUBERCLES AND CALCAREOUS DEPOSIT.
SPLEEN OF DISEASED COW SHOWING LARGE TUBERCLES ON SURFACE.

leaving this part of the discussion let me state that there has been a large amount of scientific investigation which goes to prove that human tuberculosis can be transmitted to cattle by direct inoculation, and there is little doubt of its transmissibility from animal to animal or from one kind of animal to another.

If Dr. Koch's announcement is true, it is a most important discovery. However, so much evidence has accumulated to prove that men contract bovine tuberculosis that scientists are slow to accept this new theory of Koch's and will not do so without abundant proof.

The following quotations as made by the "Literary Digest" are of interest:

From the Philadelphia Press.

"The chief evidence of the transmission of tuberculosis from cows to human beings has rested on the cases of children. The strongest proof was summed in a report lately made to the British Medical Council that 'The mortality from tuberculosis in early childhood is not decreasing as at other ages, and the opinion that this is due to infection by milk appears well founded.'

"Meanwhile, laboratory evidence accumulated that the human and bovine bacillus were not identical in shape, tests or increase. Cattle are relatively unsusceptible to human tuberculosis. It is extremely probable that Dr. Koch has carried this to full proof and developed the difference to be one of species. If, however, tuberculosis cannot furnish bacilli which gives human beings the disease, the cattle bacilli render cattle diseased. Infection once begun infects the entire herd. Unless people chose to eat diseased meat, and drink milk with bovine tubercle containing, as was found in Boston, 810 million germs to the tumbler, tuberculous cattle must continue to be sternly destroyed."

The following from the "Medical News" of New York:

"The belief that bovine tubercle bacillus is incapable of inducing tuberculosis in man is, of course, by no means new. For years there have been advocates of this side of the question. As a matter of fact, there is abundance of clinical evidence which indicates this capacity. Thus, Tscheving, of Copenhagen, in 1888, reported a case in point. The sufferer was a veterinary surgeon who wounded his finger while making an autopsy on a tuberculous cow. Local tuberculosis in the wounded part developed in a short time. Lefevre collected other equally striking examples which would be very difficult of explanation if our present view is incorrect."

The introduction to this report by Dr. Glover gives the above cases and presents abundant reason for suspecting tuberculous cattle. It will take nothing short of absolute proof to convince that bovine tuberculosis is not

dangerous to man. It is to be devoutly hoped that this is so, as it would greatly simplify the problem of ridding both man and cattle of the worst disease with which either is afflicted. Meanwhile, we should not cease using judicious caution and our researches are doubly interesting. The evidence against bovine tuberculosis has been sufficient excuse for all the laws and regulations enforced against it.

At the close of the British Congress on tuberculosis, before which Professor Koch delivered his paper, a series of resolutions were adopted, among which appears the following, as published in *Science*, Aug. 1901:

"That in the opinion of this Congress and in the light of the work that has been presented at its sittings, medical officers of health should continue to use all the powers at their disposal and relax no effort to prevent the spread of tuberculosis by milk and meat."

"That in view of the doubts thrown on the identity of human and bovine tuberculosis it is expedient that the government be approached and requested to institute an immediate inquiry into this question which is of vital importance to the public health and of great consequence to the agricultural industry."

There were over 2,500 members at this Congress including many of the world's foremost scientists.

THE TUBERCULIN TEST.

Within the past year the restrictions of this government on the importation of tuberculous cattle has given rise to vigorous protests on the part of men actuated by selfish interests. Our own people submitted to like restriction without complaint, but enforcing such regulations against Canadian cattle has given rise to what we believe are unwarranted attacks on the reliability of the tuberculin test which is used to determine whether or not cattle are tuberculous.

We think it unfortunate that some of our leading stock journals have published attacks on the test, which are calculated to mislead the public in regard to its efficiency and value. The highest authorities state that tuberculin is perfectly harmless to healthy cattle when properly administered as a test for tuberculosis. They are also agreed that it is a means of detecting the disease which is of great value and sufficiently accurate to be practically infallible. Because it gives fever to diseased animals or occasionally fails to produce its effect on such advanced cases that the disease can be found by physical examination does not seem sufficient

reason for condemning it as a diagnostic agent. It is believed that it does not fail to detect the disease in more than one-fifth of one per cent. of cases which are not far advanced in their course, and in our experience the disease has been found in every case which responded to the test.

Tuberculin is a glycerine extract of the toxin produced by the bacillus tuberculosis, but it contains no living germs which can communicate the disease. The normal temperature of an animal is obtained, then a small quantity of the tuberculin is injected hypodermically so it will be absorbed into the blood. If the animal is diseased the tuberculin causes a rise in temperature of 2 degrees or more in 8 to 16 hours, and sometimes a swelling and soreness where the injection was made. It should be used under the direction of a veterinarian or physician, or someone who has used and understands the method of applying the tuberculin and observing the results.

WHY WE TESTED THE COLLEGE HERD.

Our cattle had not been tested and we suspected the disease. However, we had only one animal under suspicion, and we hoped she would be the only case. Gildana, a Jersey cow about eight years old had been out of health for some months. She had the malignant catarrhal fever which was prevalent during the fall months, and did not recover as did other animals which were affected. She seemed to be passing into decrepid old age which we thought due in all probability to tuberculosis. Dr. Glover was consulted and he agreed to test the dairy herd. We did not expect to find many cases as we thought there was reason to believe that tuberculosis might not be so prevalent in our dry sunny climate as it had proved to be in more humid regions. There may have been a little personal pride in the thought that our cattle, which had been given the best of care under the most favorable conditions, would be unusually healthy. As we will show later this idea was not without some foundation in fact. But tuberculosis is a disease which leaves its victim hopeful and in good cheer and one about which the novice should not jump at conclusions. We guessed that Gildana had tuberculosis, but we guessed wrong, for she did not respond to the test and is now believed to be healthy, while other cows in the herd which to all appearances were healthy, were found to be veritable pest houses of infection.

Again, because cattle form so large a part of human food; because they are subject to many diseases fatal to

man, and because cattle products, as milk and butter, are used in the raw state they are a constant menace to the public health. It is important then that the greatest care and sanitary precautions should be used in handling cattle and their products. Outside of the danger to man there is the item of financial loss from the presence and spread of disease among our stock. These are sufficient reasons for every cattle owner applying every test and attention which will insure keeping only healthy stock. Dr. Bang, the great Danish authority, has succeeded in having laws passed which makes sanitary precautions compulsory in Scandinavia, and already enough has been done in Europe to show that tuberculosis may be materially decreased by proper sanitary control of tuberculous subjects among both animals and man. In Denmark national laws make it compulsory to heat all milk to 185 degrees F. before it is sold, or before butter is made from it.

In Germany tuberculous persons are required to take the sanitary treatment prescribed and they find that tuberculosis is decreasing under these laws. Many of our states have legislative regulations for stamping out tuberculosis among cattle, and some of them are extreme in requiring the slaughter of all reacting animals. If human and bovine tuberculosis prove to be the same disease, it would seem that this method would be the surest and quickest way of removing the greatest of all dangers to human life, but because of the uncertainty, we are probably not ready at the present time to adopt such drastic and expensive measures. However, enough is known at the present time so no one is excusable for using milk or butter from cows which have not been given a bill of health and demonstrated free from tubercle, and no stockman is excusable for harboring and breeding the disease in his herd.

RESULTS OF THE TESTS.

Three tests have been made of the cattle on the College farm, by Dr. Geo. H. Glover, veterinarian. The first on December 8, 1900, was of all the cows being milked in the dairy, consisting of seven Jerseys and one Shorthorn and also one Shorthorn which had lost her calf and had not been doing well for some time. Table I gives the result of this test, showing the normal temperatures determined before inoculation and the rise in temperature after injection. The maximum temperatures and total rise of reacting ani-

mals are shown in bold faced type. Unless the rise in temperature was more than 2.5 degrees it was not considered proof of infection. It will be seen that of the nine animals tested five, or 56.6 per cent. reacted.

TABLE I.
TUBERCULIN TEST MADE DEC. 8, 1900.
COLORADO AGRICULTURAL COLLEGE.

No.	Name	Breed	Wt. lbs.	Age yrs.	Nrm'l Temp.	Max'm Temp.	Hours after injec'n	Rise in Temp.	Remarks
1	Young Grannie	Jersey	1072	10	100.1	101.5	11	1.4	
2	King Lee Noble	"	1122	4	100.7	107.1	11	6.4	Destroyed. Early stages of disease
3	Gildana	"	920	10	100.3	101.2	13	0.9	
4	Kate	"	828	4	100.9	106.7	11	5.8	Destroyed. Had generalized tuberculosis
5	Lucy	"	860	4	101.0	104.9	11	3.9	Destroyed. Disease not advanced.
6	Lelia	"	770	2	101.3	105.0	12	3.7	
7	Rose Gildana	"	872	3	101.4	101.8	21	0.4	
8	2nd Orchard Girl	Shorth'rn	1376	5	100.9	102.2	8	1.3	
9	Ambrosia 2nd	"	982	3	101.7	106.0	8	4.3	Destroyed. Generalized tuberculosis

The second test, principally of the Shorthorn cattle was made January 12. The results are given in Table II. No. 1, Young Grannie; No. 2, Lee Noble; No. 3, Gildana; No. 6, Lelia Rose; No. 7, Gildana 2d, and No. 11, Ambrosia, were cows which were injected during the first test. An interesting point and one which has been urged against the test is that the Jersey, Lelia Rose, and the Shorthorn, Ambrosia, which gave reactions at the first test on December 8, failed to react to this second injection of tuberculin. It merely illustrates the fact that an injection of tuberculin renders an animal immune to the test for some time after it has been made.

The time between tests of the same animal should probably not be less than six months, and the results of a test should not be accepted unless it is known that the animals have not been injected with tuberculin for at least six months time. Therefore we did not accept the failure to react at this second test as an indication of freedom from the disease and at the post mortem Ambrosia proved to be about as bad a case as could exist and the animal continue to live, although she appeared fairly well and thrifty.

Counting out the animals tested December 8, including

TABLE II.
TUBERCULIN TEST MADE JAN. 12, 1901.
COLORADO AGRICULTURAL COLLEGE.

No.	Breed	Wt.	Age	Nrm'l Temp.	Max'm Temp.	Hours after injec'n	Rise in Temp.	Remarks
1	Jersey	1072	10	100.8	101.9	12	1.1	Second test
2	"	1122	8	101.4	106.5	18	5.1	Destroyed. Had general- ized tuberculosis
3	"	920	10	100.8	101.3	5	0.5	Second test
4	Shorth'rn	900*	2	102.2	103.3	9	1.1	
5	"	1140	5	101.7	101.2	9	
6	Jersey	770	2	101.1	103.0	11	1.9	Second test
7	"	872	3	101.8	101.9	5	0.1	Second test
8	Shorth'rn	1225*	3	102.1	104.0	13	1.9	
9	"	1240*	3	103.2	102.3	5	
10	"	1260	3	102.4	106.3	13	3.9	
11	"	1250*	3	102.8	102.2	21	Second test. Generalized tuberculosis
12	"	1050	3	102.2	106.1	13	3.9	
13	"	1190	7	102.4	102.3	9	
14	"	1075	7	102.4	102.9	4	0.5	
15	"	1320	4	102.6	102.9	4	0.3	
16	"	1135	5	101.8	102.3	9	0.5	
17	"	1300*	4	102.7	102.5	4	
18	"	1225	5	102.2	102.7	4	0.5	
19	"	1275*	4	102.2	105.8	15	3.6	
20	"	1050	2	102.5	106.5	15	4.0	
21	Jersey	800	1	101.6	103.0	12	1.4	
22	"	805	1	101.8	103.6	10	1.8	

* Estimates based on later weights.

TABLE III.
TUBERCULIN TEST MADE JAN. 26, 1901.
COLORADO AGRICULTURAL COLLEGE.

No.	Breed	Wt.	Age	Nrm'l Temp.	Max'm Temp.	Hours after injec'n	Rise in Temp.	Remarks
1	Jersey	1540*	3	100.8	101.7	8	0.9	Bull
2	Shorth'rn	1000*	2	101.9	101.0	11	
3	"	1260	2	101.8	101.3	8	
4	"	1270	12	102.5	103.9	21	1.4	
5	"	1565	6	103.6	105.6	13	2.0	

those which reacted, there were 18 new ones tested January 12. Of the 18 animals, four, or 22 per cent. reacted. This does not include No. 8 which gave a temperature rise of 2 degrees.

While we had taken the temperatures of all the cattle, not quite enough tuberculin was obtained so a third test was made January 26. One Jersey bull and four cows were tested. (See Table III.) As none gave a rise of temperature of more than 2 degrees it was not considered sufficient to prove the disease in any of them.

SUMMARY OF REACTIONS.

A total of 31 head were injected with tuberculin and 10 reacted, or thirty-two and one-fourth per cent. There were 11 Jerseys, of which 5 reacted, or nearly 45.5 per cent. Out of 20 Shorthorns, 5 gave definite reactions, or 25 per cent., and 2 doubtful cases in which the temperature did not rise high enough to be considered proof of disease.

There were in reality two herds of Shorthorns. The old herd which had been raised on the College farm or had been here for 8 or 9 years did not contain a diseased animal while the 5 cases were out of a herd of 12 animals which had been brought from Iowa one year before the test. Then there was 41 $\frac{2}{3}$ per cent. of the Eastern Shorthorns and none of the Western animals tuberculous. While this may have been an accident, we take it as significant, and probably it indicates what may be expected in a general way. It is generally believed that Western range cattle are practically free from tuberculosis.

POST MORTEMES.

Four of the reacting Jerseys and one Shorthorn have been killed and carefully examined. These examinations were conducted by Dr. Glover. In order to make the examinations as thorough and authentic as possible Dr. Glover secured the assistance and cooperation of Dr. L. Clark, a veterinarian of long standing and ability in the government employ, and Dr. R. McCarroll of Fort Collins. Mr. C. J. Griffith and the writer assisted with the work and took the notes. The College authorities were present to satisfy themselves that the disease was demonstrated and the class in veterinary science took an interested part. None of the cows had the disease far enough advanced to make it possible for the veterinarians to detect it by physical examina-

tion, but the diagnosis as made by the use of the tuberculin proved correct in every case and three of the five cows examined had generalized tuberculosis, i. e., nearly all the organs were diseased. In three of the four Jerseys examined tubercles were found in the udder where they were discharging into the milk. No attempt will be made to write a technical description of these post mortem examinations, but the following general notes will give the reader an idea of the amount of infection demonstrated:

Kate. (No. 4 in Table I.) Jersey cow, 4 years old. Reaction, 5.8 degrees. Killed and examined December 15, 1900. Carefully examined before death, but could find no evidence of disease. Cow in good condition with considerable internal fat. Had been lame and evidently suffering from effect of the injection of tuberculin since December 8. Lungs healthy except the lymphatic glands in the lungs which were hard and gritty with calcareous deposits in the tubercles. Kidney healthy, scattering tubercles size of pinhead to one-half pea, scattered over the intestines, especially the large intestine. Spleen covered with tuberculous growths. Liver with scattering tubercles and grit of small size all over surface and through the mass. Inside of womb and placenta along with umbilical cord covered with tubercles from size of grain of sand to small pea. Small tubercles found in udder. Photographs taken of cow and affected glands. Carcass burned.

King's Lee Noble. (No. 2 in Table I.) Jersey cow, four years old. Reaction, 6.4 degrees. Killed and examined December 29, 1900. Apparently in good health. Glands in lungs and those from the mesenteries affected, but not in advanced stage of disease. Well developed tubercles in the udder where milk glands were discharging over them. Photographs taken of cow before death, and of affected glands. Carcass burned.

Lucy. (No. 5 in Table I.) Jersey cow, four years old. Reaction, 3.9 degrees. Killed and examined December 29, 1900. Cow apparently healthy. All organs apparently healthy. Finally small glands from the mesenteries were found with well developed tubercles in the milliary stage. (Millet-seed like excretions of calcareous matter encysted in the glands.) Photographs taken before and after death, also of glands. Carcass burned.

Lee Noble. (No. 2 in Table II.) Jersey cow, seven years old. Reaction, 5.1 degrees. Killed and examined January 26, 1901. Though this cow was apparently healthy, inside of carcass and organs were found to be literally covered and filled with tubercles, the principal affection being in the liver, lungs, udder, lymphatic glands, placenta and umbilical cord. Hard, gritty, calcareous deposits everywhere. Carcass burned.

Ambrosia. (No. 9 in Table I and No. 11 in Table II.) Shorthorn cow, three years old. Reaction, 4.3 degrees. Killed and examined May 4, 1901. Cow apparently in good condition, well supplied with fat and with no external evidence of the disease. She had not been eating well for some time and we had been unable to get her with calf. Had a small tumor on right jaw. Post mortem demonstrated an advanced stage of tuberculosis. Ovaries and uterus badly diseased and filled with pus from the breaking down tubercles. Beside the sex organs, the spleen, liver and intestines,

along with lining of lungs and heart. were covered with surface tubercles. The lungs were very much affected, the left one being almost entirely filled with tubercles and calcareous deposits. Those who saw this dissection expressed surprise that the cow could be so generally diseased and continue to live, while in reality she had evidenced little outward sign of trouble. Photographs taken of spleen, glands and uterus. Carcass burned.

REACTING ANIMALS NOT ALL DESTROYED.

It may be well to explain why all reacting animals were not destroyed at once. Some of them were kept for several reasons. In the first place it is a matter of some interest to determine whether tuberculous animals from the East will be cured of the disease by open air treatment when brought West. Second, it is considered possible to raise healthy calves from cows which are not badly affected, by separating them from the mother at once and putting them on nurse cows which are free from disease. Third, the cows will be useful clinical material for the instruction of students in veterinary science. The reacting animals are being kept away from healthy ones and as soon as our barn is remodeled and thoroughly disinfected we hope never to put a tuberculous animal in it. With every precaution against spreading infection the cattle will be handled for a time for experimental purposes. At the same time we will speed the day when we can say that our stock is free from disease and that there is no hereditary tuberculosis or tendency to it in any cattle at the College.

CONCLUSIONS AND RECOMMENDATIONS.

1. While there is probably less disease in Colorado than among cattle from humid states, the disease is present in our herds and should receive attention.
2. Stockmen, especially dairymen and owners of family cows should get rid of the disease and not introduce more of it by the purchase of infected animals.
3. The tuberculin test is a reliable way of finding out whether cows are free from tuberculosis.
4. People should secure sanitary milk and disease-free butter, especially where children consume them. Milk or cream not from tested cows should be boiled before using. In ordinary practice any heat less than boiling should not be considered sufficient to kill the germs.
5. We do not know whether tuberculosis is commonly transmitted from cattle to man. The evidence that it is, as

presented in Part I of this bulletin is very strong. On the other hand so great an authority as Dr. Robert Koch thinks he has proved that human and bovine tuberculosis are different diseases.

6. In the state of our present knowledge of tuberculosis we can afford to take no chances by harboring infected animals, both because of the danger to ourselves and of the loss among our stock.

7. A cow may be seriously diseased so she will spread the infection to her calf or the rest of the herd and finally become unproductive and worthless herself without showing external signs of having a disease. The only known way of proving a cow healthy is by using the tuberculin test.

8. There is evidence to show that calves may inherit tuberculosis from their mothers, but it is generally considered that they are free from the disease when born and may be kept healthy by raising them on milk which is free from the bacilli.

9. Where apparently healthy cows which respond to the test are kept for raising calves they should be isolated and every precaution taken to prevent the spread of the disease to the rest of the herd. We found the sexual organs badly diseased in three out of five cows examined and do not think it would be safe to use the herd bull with them. In the writer's opinion the most profitable method is complete and conscientious destruction of diseased animals.

10. Cow stables should be regularly cleansed and disinfected. Good disinfectants are chloride of lime or a wash of equal parts carbolic acid and sulphuric acid mixed and diluted with twenty parts water. Sulphuric acid must be added slowly and carefully to the carbolic acid and these carefully to the water.