would live for years and might recover. For this reason, when it is desirable to dispose of the diseased animals or to exclude from a herd any that are tuberculous, it is indispensable as a diagnostic agent. When tuberculin is properly prepared, it will not injure a healthy animal. That it will aggravate tuberculosis already in existence, is an established fact, and for this reason it has demonstrated its value as a test. Knowing this, it should never be used unless the owner or the government intend to make thorough work of eradicating the diseased animals.

Tuberculosis has been described as a universal panzootic, and from the deaths in the human subject of this disease it can well be termed pandemic. This being evident, prevention is certainly the most rational method of making any inroad into its prevalence.

Fleming, in his "Sanitary Science," 1875, under the heading of "Prevention," says: "The only preventive measures with which we are acquainted are those of a hygienic kind—proper food and water; sufficient exercise in the open air; clean, dry, and well-ventilated but not too cold stables; and keeping the cattle from undue exposure to severe weather. As there is reason to believe that the malady is hereditary, cattle having any tendency to it should not be bred from. As the experiments which have been conducted by most competent authorities have demonstrated that tuberculosis can be induced in animals by feeding them with tuberculous matter, care must be taken that this is not given to them as food. There being much reason to believe that the disease can be transmitted by cohabitation, whenever cattle show any tendency to it, they should be isolated from the healthy, and every precaution observed with regard to preventing contact. Animals slightly affected should be fattened and slaughtered; and their flesh, if free from traces of the disease, may be utilized. The milk of such animals should be proscribed, and in advanced cases, the flesh also."

It is readily seen from this quotation that the requirements for protection against the disease, either in man or animals, are the same. It can be concisely stated in the word "hygiene." I doubt if any one will take exception to the statement that sunlight, combined with cleanliness, proper drainage and ventilation, is necessary to maintain and create a constitution capable of resisting disease. Tuberculosis is an infectious disease, and with the means we have to diagnose this malady, there cannot be any excuse why the products of tuberculous animals should be used for the benefit of man.

In a brochure issued by the State Board of Health of Massachusetts (May, 1894), it is admitted that the milk from tuberculous animals is a menace to the health of mankind, and it should be proscribed. In regard to the meat from such animals, they recommend its thorough boiling, although they do not feel confident that it will cause the disease, since clinical evidence to that effect is not in existence. Since tuberculosis is a preventable disease, undoubtedly there are cases that will recover. This being a fact, why allow or sanction even the use of tuberculous meat, when it is known that the ptomaines or tuberculin which exists in the flesh of tuberculous animals are not destroyed by boiling, and if introduced into the system of a tuberculous individual, will excite the activity of the disease. Is it not desirable to ameliorate a case of tuberculosis after the possibility of prevention has

passed? It is admitted by the producers of vaccine virus that the bovines that are used for its production should be in a normal condition, and that for this reason they are examined by a veterinarian in some instances, and at other times by a so-called "competent" man.

In an article in the *Boston Medical and Surgical Journal*, May 3, 1894, on the production of vaccine virus, no evidence is shown that tuberculin is used. Then of what value can be an opinion as regards the existence of tuberculosis in its occult form? One firm uses mature animals in order that the lymph may be richer in germs, while the other (of the two firms examined) uses young animals that are less liable to be diseased. In neither of these establishments does it appear that the product of each animal is kept by itself, nor that the animals killed are subjected to an examination to establish the fact of their normal condition.

In conclusion, let me congratulate the State Board of Health for its bulletin, as a step in the right direction for the prevention of this, the most universal and insidious of all diseases in the animal kingdom.

SANITARY CONDITION OF DAIRY FARMS.¹

BY DR. JOHN M. PARKER, HAVERHILL, MASS.

In a paper read before the American Medical Association in 1891 on "The Treatment of Chronic Pulmonary Consumption," the essayist remarks: "Our surroundings make us what we are. If our treatment could begin with the birth of the patient, in 99 per cent. of cases, we should have no tuberculosis to treat. *No matter about the family history.*" This remark applies equally well to dairy cows. *Their surroundings make them what they are.* And I venture to assert that, if the *sanitary* and *hygienic* conditions were what they should be, we would have little or no bovine tuberculosis in our dairy herds. It is the common, every-day life a person leads that governs his health; and it is the common, every-day life the dairy cow leads that governs her health and vitality. *Their surroundings make them what they are.*

Sanitary science has made vast strides in the last twenty years, yet our dairy farms are in practically the same condition they were in fifty or one hundred years ago. In fact, no effort is made on the average farm to conform to any sanitary laws or regulations whatsoever. The old barbarous practice of confining the cattle in stanchions is still in use; and the old barn and barn-yard with its strong odor and slimy filth is still in existence.

Sanitary science is advancing every year. Our cities are well-drained; our drinking-water is carefully guarded; houses and schools must have sufficient light and air; our young men and children must have exercise; but yet our dairy cattle are expected to retain their health and strength and to maintain their vitality, shut up for months in close barns, without ventilation or fresh air, and with little light—compelled to stand in their tracks unable to move; unable to turn round even to lick their sides.

It seems strange that the entire question of the sanitary improvement of our dairy farms should have escaped notice as it has. It is not a new subject. For

¹ Read before the Massachusetts Veterinary Association, May 23, 1894.

many years past, authorities have agreed that the principal predisposing causes of tuberculosis are poor sanitary and hygienic conditions, and yet notwithstanding the universal prominence given to sanitary conditions as predisposing causes, they are almost entirely ignored among the prophylactic measures suggested by many of these same authorities.

No.	No. of Cattle.	Cub. ft. each.	Ventilation.	Light.	Water.	Cellar.	Disposal of Manure.
1	7	465	None	Poor	City	Yes	Cellar
2	10	286	None	Poor	Spring	No	Outside barn
3	1	440	None	None	City	No	Outside barn
4	6	224	None	Poor	Spring	No	Outside barn
5	4	143	None	Poor	Spring	No	Outside barn
6	7	800	Stair-way	Fair	Spring	Yes	Cellar
7	7	416	None	Good	Well	Yes	Cellar
8	12	487	None	Good	Well	Yes	Cellar
9	19	1,165	Good	Fair	Well	Yes	Cellar
10	3	266	Poor	Poor	Well	Yes	Cellar
11	3	1,336	None	Good	Puddle	Yes	Cellar
12	12	233	None	Good	Spring	Yes	Cellar

In showing that sanitary conditions are not observed as they should be on dairy farms, I have attempted to tabulate the conditions as found on twelve farms in this vicinity. These are not picked out, but are taken at random from farms visited from day to day. The table shows roughly the amount of cubic space per cow; the ventilation, light, water-supply; whether there is a cellar, with its condition; and how the manure is disposed of. You will notice, as a rule, that the cattle are far too crowded. In the city of Boston each animal must have 1,000 cubic feet of space, and probably, with good ventilation, that may be sufficient, at any rate it is an immense improvement on many farms in other parts of the State; but even 1,000 cubic feet is altogether inadequate if there is no ventilation. What must be the condition of the barns then, when as in No. 5, there is only 143½ cubic feet for each animal, with no ventilation. In only three farms out of the twelve, you will notice, is there any attempt at ventilation, and even in these it is more in name than fact. And in not a single barn that I have been in is there any provision made for the admission of fresh air.

Of the twelve barns visited, four had good light, two had only fair light, five had very poor light, and one had no light at all.

As a rule, New England farms have good water; but on some farms the wells are situated too near the yard and receive the surface drainage, and in some instances the cattle are even watered in creeks and puddles formed by the surface water.

Keeping the manure in the cellar is another common practice. In eight of these twelve barns, the manure is kept in this way. At the farm referred to as No. 8, there are twelve cows, each cow with 487 cubic feet of space. This barn is well lighted; the windows facing the south; but there is no ventilation whatever, except when the door is open. This farmer makes a special boast that his cattle are not out of the barn from fall till spring. They are watered in the

barn, and the manure is dropped into the cellar below, where it is allowed to remain till removed in the spring. In making a visit to this barn during the winter, a man who was with me had to leave the barn because of the foulness of the air.

At another farm, Nos. 2 and 4, there are two barns. In one containing ten cattle, each animal has 286 cubic feet with no ventilation and only one small window for light. The other barn has six cattle, each animal having 224 cubic feet. This one also is without ventilation or sufficient light. In these barns the air was very bad.

At No. 5 there is no ventilation and only one small window for light. In this barn each animal had only 143½ cubic feet. Two out of four animals were evidently tuberculous.

At No. 10 three cows are kept in a tightly boarded pen, 10 x 10 x 8, giving about 266 cubic feet to each animal. At this barn there is a small ventilator and one small window, but in winter when everything is tightly closed, the atmosphere is fearful.

The other day I visited a barn, No. 11, and in conversation with the owner, I asked him where he watered his stock. "In the puddle outside," he answered. The puddle was a marshy place where the water lodged in wet weather. It was situated about twenty yards from the barn and formed part of the yard. The manure pile was on sloping ground at the side and drained into the puddle.

At No. 12 there are twelve cows, each having 233 cubic feet, with no ventilation whatever, the farmer taking special pains to have a heavy canvas curtain in front of the cows. This is a fearful hole in winter time, and it has the reputation of being the hottest barn in the district. This farmer is said to lose three or four cows every year.

No. 3 is a small shanty in the city with neither window nor ventilation. The water is carried to the cow, and she is in the barn winter and summer. Inside the barn is terribly filthy.

At another farm (the State Experimental Station of a neighboring State), the barn is so hot and close in winter that a friend of mine who was visiting there, had to leave and go into the open air because the hot, foul air in the barn made him sick and inclined to vomit.

These, gentlemen, are common examples of the average New England farm. Farmers have been taught to do the very things that are injurious to their stock. They have been taught to keep the manure in the cellar. What is the result? You have a damp, chilly atmosphere full of foul odors and organic impurities. They have been taught to keep the barn close and warm, and the only heat it gets is from the animal body. The hotter, they think, the better it is.

In the great majority of dairy farms there is not even a pretence of ventilation, while the cattle are packed in as close as they can conveniently be put. A cow has about four or five times the lung capacity of a man, yet on many of the farms each cow has only a tithe of the space required by a child under seven years of age, and that without any ventilation.

Fresh outside air contains only a trace of carbonic acid, about four parts in 10,000. The air of a room would be only fairly good with eight or nine parts in 10,000, yet some barns have as much as fifty or sixty parts of carbonic acid in 10,000; and I have no doubt, if the percentage were taken during cold

weather in winter when the barns are tightly shut up, the air would be very much worse. When only a small quantity of carbonic acid is contained in the air, the carbonic acid in the lungs is very readily diffused through the atmosphere; but when that atmosphere has become impure, when it contains a large amount of carbonic acid with organic impurities, then the carbonic acid in the lungs is not so readily diffused through the air — it has found its level, and is retained in the system, where it lowers the vitality, causing the dulness and lethargy experienced by any one after sleeping all night in a close room.

In calculating the amount of impurity in the atmosphere of a barn, the carbonic acid is taken as the standard of impurity only because so far no simple means has been discovered by which the other impurities can be determined, so that the amount of carbonic acid shows only relatively the amount of impurity in the air.

When a ray of light penetrates a dark place, innumerable particles are seen floating in the air. In a barn these particles of so-called dust are organic matters given off by the occupants, as well as fungi, bacteria, dried manure, and particles of hay and grasses. It is this dust that is so dangerous as a source of infection in tuberculosis. The manure, as pointed out by Billings, contains the bacilli; when dry it becomes pulverized and powdery, and along with the discharges from the nose, it mixes with the dust and chaff and the other impurities in the air which are breathed by the cattle — ventilation which would rid the atmosphere in the barn of these impurities, being altogether lacking.

Drainage, and dark and damp cellars under the barns have a close relationship to the ventilation and warmth of the barn. The wet and filth usually found in the cellar, keep the air of the barn damp and chilly; while the decomposing animal and vegetable matters give off a quantity of carbonic acid which contributes largely to swell the amount already in the barn.

The cellar is considered by many farmers to be a necessity. There the manure is kept; there odd tools and implements are stored; and if the barn upstairs gets too crowded, one or more animals will be turned into the cellar. It is always dark and damp; the sunlight never penetrates there; the manure is thrown down, the liquid portion runs along and soaks into the ground; in many cases it is a little lower than the yard, and more or less of the surface water flows into it. It is never drained; usually it is damp and wet all summer long; the ground only dries by evaporation. According to Professor Kedzie, "To evaporate one pound of water consumes enough heat to raise the temperature of five and one half pounds of water from freezing to boiling point"; or, to vary the illustration, "Suppose that a tile drain discharges constantly for one day a stream of water whose cross section is one square inch, and velocity two and one-half miles an hour, *this one day's drainage would save the heat equivalent to nearly six tons of coal.*"

Further, we must remember that barns are usually warm; this warmth causes a current of air upwards, so that this damp, chilly air is drawn up into the barn above, where it does the most harm. In referring to this condition Professor Kedzie forcibly remarks:² "The evaporation of so much water renders the air over such a soil damp and chilly. This result is a

physical necessity. This damp and chilly atmosphere has a more serious result than the simple feeling of discomfort. It has a most depressing influence on the human system, lowering its tone, enfeebling the vital powers, and acting as the predisposing cause of a long list of diseases, some of them the most destructive and incurable known to the medical profession. The depressing influence of the dampness and chilliness of a water-soaked soil is not to be compared to the effect of an occasional wetting, as when we are caught in a shower; the chilly dampness of the undrained soil is persistent and unrelenting, dragging us down with its cold fingers at all hours, at 'noon of day, and noon of night,' as if we toiled and rested, waked and slept in a perpetual drizzle of cold rain. It may seem a small force at first; but its persistent, untiring and relentless pull tells upon the strongest at last like the invisible fingers of gravity which finally drag down all to a common level. This depressing influence is not developed suddenly and distinctly; but silently and secretly the sapping and mining go on till the explosion comes in sickness, suffering, and the sleep that is eternal."

If it is necessary to have cellars, then it is most essential that they should be well drained, well lighted and well ventilated; and the manure, instead of being dumped into the cellar, should be carried some distance from the buildings. Care should also be taken that the well is not situated so as to receive the surface drainage. Too often the well is situated in or near the barn-yard, and I have known cases where through either ignorance or carelessness, the cows were watered from a puddle or hollow near the barn into which the surface water from the barn-yard drained.

Light is another essential that is almost entirely neglected. Good light is just as essential to the health of the "higher animals as it is to plant life." We ordinarily get too much in the habit of viewing light in barns, as being simply for the purpose of enabling us to see what we are doing. Light, however, has a direct bearing on the health of the body, and an even more direct influence on the causation of this special disease under consideration. Light is especially necessary where, through want of exercise, the circulation is sluggish and the system is depressed; light will stimulate the circulation. It increases the oxidation; more carbonic acid is given off, and the functions of the whole body are quickened and enlivened; but sunlight also retards the growth of germ life, and more than that the vitality of certain forms of bacteria, including anthrax and tubercle bacilli, is destroyed by the action of light. So that while light is necessary for the healthy development of the higher forms of life, it is detrimental to the lower forms of life. And yet in how many barns are we able to see distinctly? In how many barns can we even see to read a thermometer without going to the window?

Nor are the above the only conditions that tend to impair the health of the dairy cow. On the average farm no care is taken, not a single precaution is observed to prevent the health of the dairy cow from breaking down under the strain to which it is subjected. Everything is made subservient to the one sole and single object of getting a large milk-supply.

One would think that common-sense would teach that to keep cows for months without their stirring out of their tracks, is, to say the least of it, an unnatural condition of things. Exercise is just as necessary

² New Hampshire Board of Health Report.

for a cow as it is for the rest of the animal kingdom yet it is something the dairy cow does not get.

Every one knows that exercise increases the flow of blood to the muscles; and in consequence of the greater amount of waste products carried off, and the greater amount of oxygen required by the system, a quickening of the heart's action and a quickening of breathing result. On the other hand, when little or no exercise is taken, the circulation becomes sluggish, and the heart, like any other muscle, degenerates for want of use; the breathing becomes shallow, and the lungs are not expanded. When any extra strain is put upon them, they are not able to do their work; and we have rupture and permanent dilatation of air-cells, along with weak lungs and a predisposition to pulmonary disease.

Exercise, on the other hand, causes an increased flow of blood to the lungs, with an increased vitality and strength. The increased flow of tidal air in and out of the lungs will tend to prevent the slow-growing tubercle bacilli finding lodgement, and in this way prevent their growth and development in the lungs.

In referring to exercise, I don't wish to be understood as advocating a large field or range for the cattle to run over. I don't wish to advocate anything impractical; but I do think that the present method of confining the dairy cattle with stanchions is capable of improvement. I do think they ought to be allowed their liberty; and further I do not see anything impractical in any such suggestions. Any condition that affects the comfort of the animals must affect their general well-being. Every one here must have seen how cows will rub and scratch themselves when first let out for water; often, even when thirsty, they will not touch the water till they have first licked themselves all over. It is impossible to stand behind a row of cattle for five minutes without seeing one or the other make a more or less ineffectual effort to scratch the body. No animal can be comfortable confined as they are in New England at the present time.

Every one knows that these conditions exist and are detrimental to the health of the animal. Then why are they not attended to? It is because through force of habit we have got accustomed to them, we simply take it for granted that these conditions cannot be improved.

THE AGRICULTURAL ASPECT OF TUBERCULOSIS.¹

BY DR. W. R. SESSIONS,

Secretary Massachusetts State Board of Agriculture.

It is but a few years since tuberculosis in cattle was known to the public to be prevalent. The attention of scientists, particularly of veterinarians, has lately been directed to the disease as a source of danger to the life and health of the human family. Investigations have proved the disease to be generally prevalent among the cattle in all thickly inhabited countries, although most of the cattle affected show few outward indications of the disease. In fact, a large majority of such infected animals are apparently healthy, and the presence of the disease cannot be detected with certainty without the use of tuberculin.

The danger to human life and health has been discussed and magnified until the public are demanding

action by the State authorities for their protection. Authority has been given the Cattle Commissioners to kill without appraisal all cattle found to be infected with the disease.

The discovery that the injection of tuberculin is a very reliable method of detecting the disease has led many to believe that this should be applied by the authorities to all suspected herds, and some people are of the opinion that all the cattle of the State should be subjected to this test. From the experience thus far had in the use of tuberculin, we are led to believe that a large proportion of the cattle that are apparently healthy would be condemned by this test. The present law provides no recompense to the owner of such cattle. These conditions make the agricultural aspect of tuberculosis very serious indeed. The neat stock of the State is rapidly decreasing, the decrease having begun with the agitation of the danger from tuberculosis. In 1890, 200,658 cows and 62,549 neat cattle other than cows were assessed. In 1893, 186,806 cows and 47,528 neat cattle other than cows were assessed, a decrease of 13,852 in cows and of 15,021 in other neat cattle, making a total decrease of 28,873 in three years. The number of cows had been previously quite steadily increasing for thirty years from 149,090 in 1861 to 200,658 in 1890.

The dairy is easily the most important branch of farming in Massachusetts. The State Census of 1885 gives us the latest reliable figures. By that the value of dairy products was \$13,080,526; hay, \$9,676,893; other staple products, \$4,578,763; fruit, \$2,386,290; vegetables (potatoes are included in staple products), \$2,762,941; animal products, \$5,398,439. The hay crop is quite largely dependent upon the dairy interest, and the animal products are so largely dependent upon the dairy as to be almost a part of it. The veal product is certainly a dairy product, and most of the veal of the State is grown on the skim-milk of our dairies.

If the killing of tuberculous animals is to go on without compensation to the owners, this most important industry must rapidly decrease, carrying along with this decrease a still greater decrease in the value of much of the farming property of the State. The fine dairy barns that dot the farms of the State will become valueless, and the pastures will be allowed to grow up to brush. The State can ill afford a decrease in its agriculture and in its agricultural population. If the fight against tuberculosis is for the public good, the public should make part, at least, of the sacrifice deemed necessary. Especially is this proper in view of the fact that many cases of tuberculosis in human subjects do not terminate fatally and many apparently recover. I quote from "Tuberculosis in Relation to Animal Industry and Public Health," by Dr. James Law. "Dr. Biggs tells us . . . that in the Charity Hospital of the city [New York], 30 per cent. of all deaths show old lesions of tuberculosis now becoming stationary. He quotes a Vienna hospital pathologist to the effect that he finds similar old stationary lesions in 85 per cent. of all post-mortem examinations. This leaves but 15 per cent. who have not suffered from tuberculosis." It is not too much to claim that a like proportion of bovines slightly affected with tuberculosis would never be apparently injured by it. Such cases should be paid for in full, if sacrificed for the public good. But it would be difficult for the officials to discriminate in the matter of allowance for cattle killed;

¹ Read before the Massachusetts Veterinary Association, May 23, 1894.