

Prof. Reynolds on Stable Ventilation.

In a country where the live stock necessarily spends several months of each year indoors, proper ventilation of buildings is the very first requisite towards the maintenance of sound health. We are gratified to find that the subject has come to the front despite spasmodic attempts to magnify the tuberculin-test fad. Farmers and stockmen have taken a keen interest in the series of articles running through the FARMER'S ADVOCATE, describing the systems recommended by Prof. J. H. Grisdale, of the Ottawa Experimental Farm; by Mr. H. S. Foster, of Quebec; by Prof. H. H. Dean, of the O. A. C.; by Mr. Isaac Usher, and others. Prof. J. B. Reynolds, of the Ontario Agricultural College (Department of Physics), has made a special investigation of the question, and, as a great many new stock barns are now being erected and old ones reconstructed, we have asked him to discuss a couple of enquiries just received from two different localities, bringing out points of general value. In one the general principles are stated, and in the other a practical application is made. The following questions in the letter first mentioned are from Mr. E. A. Garnham, Elgin Co., Ont.:

1. "At what place in the stable should the fresh air be admitted, and why?"

The fresh air should be admitted at the points where it will do the most good, and in such small quantities as can do no harm by creating appreciable drafts. The fresh air is needed principally for breathing purposes, and therefore should be admitted near the heads of the animals in the stables. If there is a forced draft, such as is caused by making use of the force of the wind outside, the best point for admitting the fresh air is at the floor, immediately in front of the stalls. It has been found that cold fresh air passing into a stable at the ceiling causes the deposition of moisture, which is avoided if the air is introduced at the floor.

2. "Where should the impure air escape, and why?"

For perfect ventilation, the impure air should escape at the ceiling immediately after it has left the lungs of the animals. The air which has just been expired from the lungs of the animals is 30 or 40 degrees higher in temperature than the surrounding air; and being warmer, it is lighter (bulk for bulk), and consequently tends to rise to the ceiling, where it may be drawn off almost immediately. But perfect ventilation is not practicable, especially in stables, since the question of temperature has to be considered as well. The air of the stable is partly warmed by the mixture with it of the warm air from the lungs of the animals, and in that way the warmth of the stable is partly maintained. The object of practicable ventilation is to remove parts of the impurities, and to maintain the air of the stable at a definite standard of purity, it not being practicable to remove all of the impurities as fast as they are driven from the lungs of the animals, since such rapid removal would mean too low a temperature. When the temperature of the stable is too low to admit of warm air being taken from the ceiling line, the impure air must be drawn from the floor. On this account, it is advisable to provide in the foul-air shafts openings at the floor line and also at the ceiling, the latter being provided with arrangements for closing when required.

3. "The size of the in-take and that of the escape; and if any difference, why?"

The amount of air required for good ventilation in stables is as yet largely a matter of conjecture; in fact, it is as yet a question as to how much can be admitted without lowering the temperature too greatly, not how much each animal actually needs. Therefore, so much depends upon circumstances—that is, upon the construction of the stable, whether warm or cold; upon the number of animals in the stable, and upon the velocity of the wind and the temperature outside—that no definite rule can be laid down as to the amount of air required for each animal. I think I am safe in saying that a fresh-air box one foot square, inside measurement, will carry the minimum amount of air for ten animals; that is to say, for every ten animals there should be at least one square foot of inlet pipe. The size of the outlet should be slightly greater, but not much greater, than that of the inlet, for the reason that the outgoing air, being warmer than the incoming air, occupies larger space. There is danger, however, in providing too large an outlet, which results in down drafts.

4. "Is the air after being breathed by the cow heavier than before, or than pure air?"

This question has been answered in No. 2, but the simple answer, without further explanation, may lead to wrong conclusions. The air just emitted from the lungs is likely to be lighter than before it was breathed into the lungs. This, however, is principally a question of temperature. If the animal is breathing air of a high temperature, 90° or above, then the air before being breathed may be lighter than the expired air. In any case, the expired air in a short space of time becomes, by being mixed with the surrounding air, of about the same temperature as the latter; but this does not quite settle the question as to the proper points for drawing off the foul air. We hear of the carbonic acid gas, a product manufactured in the lungs of the animal, and of aqueous vapor, also coming from the lungs. These are the two principal products

which ventilation is required to remove. The carbonic acid gas at the same temperature is considerably heavier than air. Aqueous vapor is considerably lighter. It might be supposed that when these two products, after being expired, have reached the temperature of the outside air, the carbonic acid gas settles to the floor, and the aqueous vapor rises to the ceiling. As a matter of fact, however, both of these products diffuse almost uniformly throughout the whole space, so that at whatever height in the stable the foul-air outlet is placed it will draw off almost the same proportions of these products. Of course, if there is any difference, the carbonic acid gas is found in greater quantities near the floor line, and similarly the aqueous vapor at the ceiling.

5. "In case where two rows of cows are standing with heads to an alley, should the escape be in the alley, behind the cows, or at both places?"

If the fresh air is admitted in the alley, then the escape should be behind the cows, in order to provide for a complete circulation of air through the whole stable. Otherwise, with the inlet and outlet both in the alley, the air behind the cows will be stagnant.

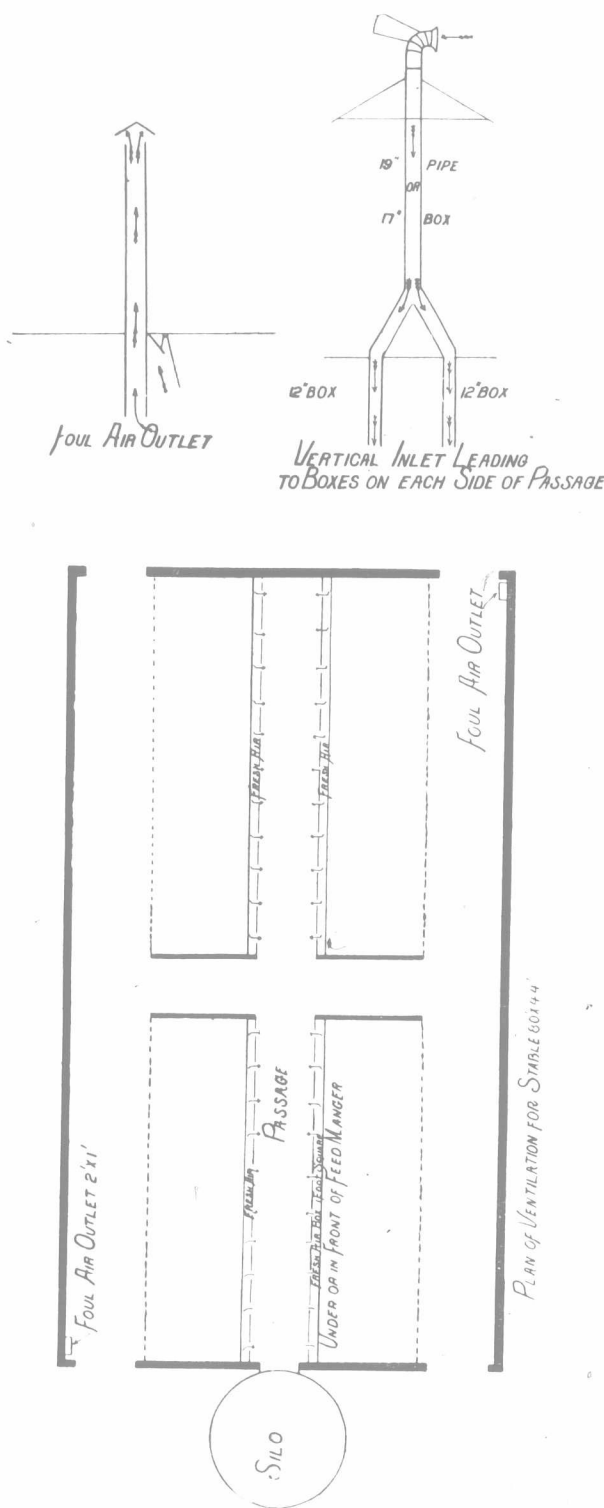
J. B. REYNOLDS.

VENTILATION SYSTEM FOR LARGE BASEMENT BARN.

Q. "I have just begun work on my new basement barn, 80 x 44 feet, with ceilings 8 feet 8 inches high, to house 42 head of full-grown cattle, which will stand in two rows, with heads to a feed alley running through center. From passage in rear of cattle the manure will be drawn out by team. As I cannot use the ventilation system advised by Mr. H. S. Foster in your paper for April 15th, I would be obliged if you would describe in your next issue a simple, efficient, and not too expensive plan to provide my stock with constant fresh air without being too cool in winter. My silo will stand outside at one end, opposite feed alley. The barn will stand on a hill, with no trees or obstructions near it. Concrete walls and floor."

Middlesex Co., Ont.

[I beg to suggest the following plan of ventilation in reply to this question (see plan):



The fresh air is conducted to the stable by means of a revolving cowl, which is constructed as shown in the figure. This cowl always faces the wind,

and, therefore, the one great difficulty in stable ventilation is met, viz., a force to keep up the circulation. In order that the full force of the wind may be insured at all times, this cowl should stand just above the peak of the barn. The pipe or box with which it is connected should pass down through the barn to the floor. On reaching the barn floor it is branched, one branch going to each side of the main passage in the stable below, and connecting with the fresh-air box, which passes along the floor immediately under or in front of the feed manger.

If the stable arrangements are carried out as the plan shows, two of these cowls will be required, one at each end of the stable. A 19-inch circular pipe or a 17-inch wooden box will convey a sufficient amount of air for half the number of cattle mentioned in the question. The branches from the barn floor down and along the stable floor should be each one foot square, so that the outfit required would be two cowls, two pipes or boxes leading from the cowls to the barn floor, four branches from the barn floor to the stable floor, and four boxes along the floor for distributing the fresh air. The boxes along the floor should be provided with 4-inch openings, cut in the face of the box, opening out into the passage—one for each animal.

Outlets.—The outlets may be placed at any convenient points around the walls. Of course, the more of them the better; but, practically, two of these outlets will be sufficient, and the area of them should be equal to or slightly larger than the total area of the inlets; that is, 4 square feet. I have indicated a possible position for these outlets in opposite corners of the stable. The Fig. 3, at the left, shows a vertical section of one of these outlets. A wooden box, 2 x 1 foot, or slightly larger, beginning near the stable floor and continuing up through the barn and through the roof, will answer. The bottom of this ventilator should be left open at all times, so as to draw off the air from the floor. In addition to this opening, another should be placed in this box, near the ceiling of the stable, and provided with a lid worked by a string, so that it may be opened or closed as required. In warm weather it should be open, but may be closed if the stable is cold. The advantage of having two openings for foul air, one at the floor and the other at the ceiling, is that the temperature may be controlled by opening or closing the upper one; and also since the moisture in the stable tends to collect at the ceiling, the ceiling outlet provides for its escape. Therefore, it should be left open as much as possible.

In this particular case it may be found advisable or necessary to have one cowl for admitting fresh air, instead of two. This plan would be cheaper, and almost as efficient. If this is done the cowl may be erected at either end of the stable (in order not to interfere with operating horse-fork car), or over the middle, and the air distributed from it after the same general plan as is shown. If one cowl is made to do the work of the two, as described above, it will require to be 27 inches in diameter.

Advantages of this System.—The advantages of the system here outlined are:

First—That ventilation at all times is insured. On account of the exposed position of the cowl, and of the fact that it always faces the wind, it will rarely happen that there is no movement of air in the stable.

Secondly—The fresh air is evenly distributed at the places where it will do the most good—that is, immediately in front of the cattle, so that they are breathing fresh air.

Thirdly—As there is a constant circulation of air by this system, there will be little or no danger of dripping—that is, of moisture condensing in any part of the stable. Providing outlets at the ceiling also tends to lessen this danger.

Fourthly—The system requires little or no attention. The ventilators do not have to be opened or closed with every change of wind, the only attention required being in the case of extreme weather, when the ceiling ventilators may require to be closed.

I may add that the inlets should be provided somewhere with shut-offs, so that in case of very high wind they may be partly closed, as, of course, the amount of fresh air which comes into the stable depends upon the velocity of the wind outside.

Cost of this System.—A 19-inch cowl, made of galvanized iron, costs about \$7, and a straight pipe, of the same diameter, costs about 40c. a foot in length. A wooden box, of course, costs a good deal less, and if made fairly tight, is equally as good as a galvanized-iron pipe. All of the parts of the fresh-air box along the floor need not be specially provided, since the floor, if tight, may do for the bottom of the box, and the front of the manger for this box would be simply a board for a face, and perhaps another board for the top.

Cheaper systems than this may be described, but I know of none as effective as this and costing less. There are plans of ventilation that will work fairly well under favorable circumstances, but are a nuisance under other circumstances. There are plans of ventilation that require almost constant attention. In a barn of this dimension, with, likely, all modern improvements in connection with it, a few extra dollars expended in a good system of ventilation will be repaid many times over in increased profits and increased comfort for cattle and men.

J. B. REYNOLDS.]