

accelerated by the motion of air, drafts, &c. This natural tendency of the various kinds and strata of air to mix with each other, has a more powerful effect than all ventilators, fans, or bellows.

The more inert watery vapors, and some kinds of gas originating from the decomposition of the excrements, are more liable to become stagnant, and will, even if they do not directly menace the life of the animal, still be productive of disturbances in some organic functions, and thus be detrimental to health.

The products of this decomposition, for instance, carbonate of ammonia and sulphuretted hydrogen, will particularly show their effects where manure is purposely suffered to remain for weeks, especially in winter, in order to use the heat, generated by the decomposition, for warming stables, and to prevent cold air from rushing in on the removal of the manure. But these kinds of gases, far from sustaining the process of respiration, will, by their caustic properties, affect the animals, irritating the pituitary membranes, nose and eyes. If from the equalization referred to above, special contrivances for the circulation and purification of air should not be ranked among the indispensable wants of a stable, yet they would favor the preservation of health, the comforts and development of power of the occupants.

There has long been a desire, therefore, and several efforts have been made, to provide stables with effective ventilation. Most of these methods evince, at least, good intention, but too openly betray a want of knowledge of the respective laws of Nature. I will now briefly notice some of the most familiar methods of ventilation.

Thus, openings made in the floor, if corresponding openings be not made above, or at the opposite wall, will have no effect, or if any, the draft will generally injure the animals.

Drafts immediately below the ceiling are not altogether objectionable, as they allow the air to pass out from the upper strata; if they are not too wide, the atmosphere carried out will not be supplied through the same opening, so that no cold current will descend upon the animals standing near, the air being supplied through the numerous cracks and pores of the building, thus not causing too great a draft. If the openings are somewhat wide, they should not be in the neighborhood of the horses. A simple opening like this will, however, then cause only a brisk circulation of air, if the difference between the heat of the stable and that outside is a very considerable one; if the temperature both out and in is equal, an imperfect purification of air will be produced. In these cases the restoration of air, could, without injury to the animals, be easily effected, by occasionally opening windows and doors.

Coleman's method of ventilation, so much spoken of in England, consists in the tray-shaped standfloor, having a grated hole carrying out the urine by a gutter beneath. In front and above the head of the horse is a draft channel, leading upward, so that, by the cooperation of the gutter and chimney channel, a change of air is continually maintained, conveying the vapor through the chimney. This arrangement has only come into limited use, because the constant draft against the belly of the horse frequently produced colics and colds. Similar to this case seems to be the ventilation recommended by Henry Stephens,

in his book on rural and domestic economy. According to his method, there should be an opening in the front wall of every stand, above the head of the horse, so as to admit the necessary quantity of air directly to the nose of the horse. He says this method requires several openings, which need not be large. These should be covered with perforated zinc, and, if the current of air should be even then too strong, it is advisable to interrupt it by a board, so fastened to the wall as first to drive the air upward before descending on the animals. Drafts at other places of the stable are deemed impracticable by Stephens, because the air thus admitted would, before reaching the nose, necessarily pass over the body of the horse, or fall upon his limbs.

It seems that the object contemplated could not be accomplished by this method, for the narrow and high openings will carry out the upper strata of heated air without admitting fresh air; if the latter should ever happen, such a current of fresh, and, under certain circumstances, of very cold air, rushing directly upon the head and forehead of the horse, could have but an injurious effect. A change of air should always be procured in those regions of a stable where the horses do not come into immediate contact, but where they do, equalization of temperature, and the mixture of air may be confidently left to Nature.

Those methods of ventilation are invariably best, which can always, and even when the horses are in the stable, be kept in operation without injury to the animals. Such are the air chimneys built perpendicularly into the ceiling, just above the passage-way, terminating above the roof.

It is well known that the heated strata of air, being specifically lighter, have always an upward tendency, assuming, in case they are not cooled off, a certain flight or draft, which is brisker in proportion to the height of the heated column of air thus put in motion. Simple openings above (without chimneys) will therefore bring about only imperfect motion and purification. The air which slowly moves up through the openings is cooled too rapidly by the temperature outside, so that it is soon interrupted in its ascent, permitting the cold air to rush in through the same passage. Those parts of air at a greater distance from the openings adhere, as it were, to the ceiling, become stagnant, and are not renovated. Quite different is the effect of the vapor chimneys referred to, setting at first the upper layers of air, and consequently all the rest in motion, because the draft generated by the long tube is just as strong as that produced by high chimneys. Vapor chimneys are sometimes used, but in their arrangement frequent mistakes are committed; in most cases they are too wide, if four boards are joined to form a conduit, as is commonly done, the current, on account of the width, being about one square foot, becomes too slow, for the ascending air is cooled before reaching the upper end of the channel; the watery vapors contained in the column will therefore concentrate and descend as rain into the stable. Therefore it becomes necessary to suspend a basin from the ceiling to catch the dropping water, which is apt to overflow upon the floor and on the animals.

But if the conduit is made narrower, perhaps half the width of the

boards and about one fourth of a square foot, the inclosed column of warm air will rise upward with more energy, forcing up the condensed watery vapors, which are in the act of falling back and preventing at the same time a current of cold air from rushing in through the same way. With regard to these ventilators, an essential advantage, usually lost sight of, may be gained to increase their effect by surrounding the conduit throughout its whole length with non-conductors of heat, so that the warm air in its rising shall not be cooled too rapidly. The advantages of such an arrangement are shown by the fact that air channels leading through full haylofts and out at the roof do not produce any dropping, not even in seasons of great cold. If by the consumption of the hay, which preserves the heat, the conduit is cooled, dropping will commence at the lower termination; therefore, if it leads through an empty space, it should be surrounded by straw, or be made of double boards, and further protected against humidity by painting the inside with tar. The terminus is protected from rain, snow, &c., by the application of a little roof, either of wood or sheet-iron, or by blinds. At the point where the conduit passes the ceiling, a valve or turning-dish should be placed so as to close the channel at will and regulate the current.

To promote ventilation in a still more rational way, openings which can be closed should, in my opinion, be made on the floor, at places where no animals stand, in order to supply fresh air in lieu of the warm air carried off; yet the doors and the cracks in the building will frequently do this, even in a greater degree than may be required.

At the outer terminus of the channels there is always a precipitation of humidity, tending to destroy the wall and the adjoining wood. Therefore, to lead away the discharged air to some distance from the building, by means of boards or projecting conductors, would be advisable. This is especially important if the openings are just below the roof, the wood-work of which is liable to destruction by the action of the vapors.

*Cribs.*—These serve the purpose of laying short fodder before the horses; for instance, oats, groats, beans, and choppings. Sometimes, also, they are used for receiving the drinking water. The height of the cribs, in most stables, is from three and a half to four feet from the floor, but it is more reasonable to adapt the height to the size of the horse, and most suitable to let the edge of the crib correspond in its height with the elbow of the horse. A lower position, it is true, would be more natural to the animals in feeding, but they would too frequently jump with their fore feet into the cribs, thus injuring the latter and themselves. Too high a position of the edge of the crib, on the contrary, would be inconvenient for taking food, and often cause the fodder to be spread about, as the horses, in order to avoid the upward stretching of their necks, turn themselves, with their mouths filled, from the crib, thus dropping the fodder in the act of chewing. A height of the crib equal with the withers, as it is frequently found in stables where small sized horses are kept, favors, and even incites to *cribbing*.

The width of the crib should be such as to allow even the largest horse to use his jaws with ease to the greatest extent; it should there-

fore be from ten to twelve inches. The length need not be more, strictly speaking, than the dimensions just referred to, thus giving a circular form; but cribs are generally made longer than would seem necessary, because horses frequently stop eating and turn their heads aside, thereby losing fodder, if the vessel is so short as not to receive the droppings; it should also be a recipient of the fodder falling from the rack. In this respect, cribs occupying the whole width of the stand are very suitable.

They are made either in the shape of gutters or of troughs. Their form should be such as always to collect the fodder again by itself in the middle, and confine it when stirred; there should not be any sharp angles, edges, or corners in and about the crib, because the fodder could not be reached everywhere with ease, and the horses are liable to hurt themselves by knocking, thus causing bony excrescences, especially on the lower jaw; finally, the front exterior of the crib should always be well rounded, downward, so as to render the horses unable to remove the halter by means of the sharp edges.

Figure 4, plate 2 represents one of the most suitable cribs, having the advantage of the edge bent back and inward, preventing the throwing out of the fodder, being easier done in other cribs made either in the shape of gutters or troughs. This crib is made of cast-iron, in Wasseralfingen, usually weighs seventy-five pounds, and costs about three and a half cents a pound. The only objection is, that the angle formed by its perpendicular back wall and the rounded bottom is too acute, so that the horses can only procure the last particles of food by the exertion of licking them. In English stables, a special drinking trough is usually joined to the crib and rack.

With regard to cleaning, cribs made of cast-iron, stone, or delf-ware, and put into a frame, like a kettle into an iron hearth-plate, are very convenient.

The material used for cribs is wood, stone, or iron. Wood should be decidedly rejected, as it causes a great many injuries. Horses are tempted, by its use, to *crib*; it requires many repairs, and gases of bad odor and contagious substances will strongly adhere to it. The use of oak wood renders the expense not much less than that of stone, especially if it is considered that they require nails and sheet-iron coverings, making them even dangerous for the eyes of the horse.

Cribs running through several stalls, and made of one trunk, are expensive and wasteful of wood; the heart of the wood is cut out, while the external and soft wood remains; repairs are difficult; and if the crib is of boards joined, angles and joints are produced, in many cases giving the first inducement to *cribbing*. All cribs, however, running through, should be provided with partitions for each horse, otherwise the envy of fodder will often excite quarrels.

Stone, under ordinary circumstances, can be best recommended as best for cribs. The only objection is that most kinds of stone are liable to a considerable extent to wear out all objects brought frequently in connection with them, for instance, the halter-chains, teeth, &c., besides, they are not cheap.

The long stone troughs are usually wainscoted at their lower edge down to the floor, partly to prevent injuries to the head and fore-feet

from the lower part of the trough, partly to gain a space for storing away litter, in which latter case the wainscoting should be provided with drop-doors capable of being locked. All these wainscotings are decidedly objectionable, being expensive and a chosen retreat for all vermin, rats and mice. To avoid the injuries indicated, the cribs should be well rounded, or the empty space filled out with a wall below. To keep litter in these places shows a want of rational arrangement. They are intended to hold the straw during the day, where it may dry, again to be used as litter for the night; but who would select so narrow and confined a space for this purpose? The dampness and gaseous evaporations from the straw is for the most part such as to injure the eyes, and the organs of respiration, with which they unavoidably come in contact.

In countries where stones are rare, earthen or delf-ware is frequently used for making cribs; they are clean and neat, but very fragile; those made of only one piece are a matter of luxury; but those composed of several plates, like earthenware stoves, are more generally used; similar to the latter are those constructed of burnt clay, as generally used in the northern parts of Germany.

Iron, on account of its hardness and durability, is especially adapted for cribs. In most cases they are made of cast-iron, and have the great advantage of preventing the horses from cribbing, of being rapidly and easily put up, removed, or transferred, in most buildings, and of retaining the greater part of their value, even in case of their being broken, or disused as cribs. A disadvantage connected with them is, that white horses, or such as have white marks about their heads, will frequently receive a dirty appearance from the rust of the cribs, giving, in point of cleanliness, a good deal of trouble to the hostler. To prevent oxydization several means are employed, the best still appearing to be that of enameling, or galvanizing, but the expense is considerable.

Another means of preventing this vessel from oxydizing consists in giving it a coat of oil, which, it is true, will not last long, if the crib is in use. If the latter is the case, a very corrosive or injurious rust will never be formed, this appearing only in the shape of a bronze color, as happens in the case of rifle barrels. If, however, the cribs are not to be used for some time, the corroding oxydization should be prevented by greasing or painting with oil.

Cribs of stone or wood are fastened either by walls below, by fixing them to the wall, or by placing them on wood or stone pillars. In running stables, cribs and racks are put up in one of the corners. In stands for mares, the foals are supplied with special cribs, rendered inaccessible to their mothers either by a pole laid across in the corner, below which the foals may still pass, or by cross-bars at the top of the crib, admitting only the small jaw of the foal to take the fodder from its reservoir.

In studs where there are many foals, the cribs may be so constructed as to be suspended from ropes, by which method the gnawing of the cribs can be avoided, because they are not steady, and may be drawn up to the ceiling, after feeding, so as not to trouble the foals in their quick movements, and to remove every inducement to crib.

In stables intended to receive cribbers, or horses inclined to crib, the

latter should be in a low position, about one foot from the floor, because it would then be impossible for the horse to indulge this propensity; and if he is, by being shortly tied, deprived of every other opportunity, for instance, the dividing pole, for cribbing, then this bad habit will sometimes in a brief period be entirely forgotten, never, under favorable circumstances, to be resumed.

Care should be taken, in making and fastening the cribs, so as not to leave cracks and openings, in which remains of fodder or single grains would lodge, as this would be the first incitement to cribbing.

*Racks.*—These are an apparatus of grated walls, of different forms, for the purpose of offering the long fodder to the animals, without any of it being lost or spoiled. A loss of fodder will be caused by being often trodden upon by the horses, and thereafter refused, besides, the fodder will be deteriorated by becoming damp in consequence of being breathed upon by the horses. The rack is trellised, to allow refuse, for instance, small stones, pieces of lime, and the pericarps of colchicum autumnale to get out of the fodder and fall through the trellis-work; besides it would be impossible for the horses to reach the fodder if the racks were not grated. The space between the rundles should be from two to three inches.

Racks are usually made over the cribs, at one and a half feet above the edge of the crib. The object of this high position is to accustom the horse to a fine erection of his fore part, a matter of consideration, as it is thought, in riding-horses, and possesses the additional advantage that the particles of fodder dropping through the rundles will fall into the crib, where they may be taken up again by the horse. These advantages, however, partly imaginary, partly real, as they are, are met by many disadvantages. The giving of food in such high racks is troublesome, and can hardly be done by small persons; the horses, also, are sometimes injured by the fork. It is impossible to prevent the head, mane, and eyes from being soiled by fragments of hay and other rubbish dropping from the rack, and giving rise to itching, rubbing, shoving off the halter, inflammation of the eyes, &c. The racks having a high position, more fodder will be dispensed and wasted, parts of which, for instance, straw of peas and beans, may even be liable to fall into the ears of the horse, giving a great deal of trouble.

These latter evils might be prevented by placing the racks somewhat back in the wall, or by bringing the front of the rack at least on a level with the wall itself, as is often seen in stables where the fodder is given from the barn, for instance, on the farms in Holstein and Hanover. The rundles in this case are given a perpendicular position, and the back part of the wall, not being trellised, forms an oblique plane, so as to enable all fodder to come gradually and of itself to the horse. High racks will always be accompanied by the disadvantage of forcing the animal, when eating, to give his head a tiresome and unnatural position, even dangerous to his health. By this forced position of the neck the circulation of blood is disturbed, causing perpetual congestions in some animals, especially those so predisposed. From all these considerations, I feel induced to advocate the position of racks used in English stables, where they are of equal height with the cribs,

being from three to four feet from the ground. It may be objected that this position would favor cribbing, and that the horses would sooner jump into the rack, spoiling it and hurting themselves; but if both cribs and racks are made of iron, and not altogether too low, these objections deserve no consideration.

The proportions of a rack should correspond to the method of feeding. Horses used for agricultural purposes receiving a greater bulk of fodder, especially green fodder in summer, necessarily require a larger rack, than those kept for luxury alone and receiving the smaller portion of their food in the shape of rack fodder.

The form of the rack should correspond to the crib, in case it is placed either above or side by side with the latter. It is objectionable to put up a long ladder-rack above a narrow tray-shaped trough of stone or cast-iron, the former stretching its ends over the trough, so as to let the fodder from the rack fall to the ground, both on the left and right side. In running stables, the crib and rack are frequently put up on different walls, or in different corners, in which case there appears no necessity for the form and size of the rack to correspond with that of the crib.

Figure 5, plate 2, illustrates this arrangement, made of one piece, by Cottam and Hallen, London, or by Brandon, Paris:

It costs, when of cast-iron.....	69 francs.
Enameled.....	59 “
Galvanized.....	100 “
Crib and rack of one piece.....	60 “
Enameled.....	79 “
Galvanized.....	88 “

The racks most generally in use are those in the shape of a ladder, with rundles at narrow intervals, either running through a number of stands, or separate for each stand. The latter arrangement has the advantage, that, if a rundle is accidentally torn off, the whole row of horses will not be exposed to excitement and danger. The position of these racks should be at an angle of 40° to 45° toward the wall.

Some have the rundles made movable, to facilitate the pulling out of the fodder, and to diminish their tearing and spoiling. For similar reasons, the racks in Holland and Belgium are provided with this arrangement: one of the rundles can be shoved up, and has a handle at the lower end, in the shape of a crutch handle, by means of which the horse is enabled to move up the rundle by putting in his nose, and to take out the fodder. (See figure 6, plate 2.) But I cannot ascribe any great value to this arrangement, inasmuch as in most racks of this kind, which I have seen, the rundles intended to be movable became so tight by the swelling of the wood, or the oxydizing of the iron, that the object contemplated could not be attained at all. Sometimes the racks are made of small boards, inserted into the grooves of the upper and lower ladder-beams, and in which the necessary openings are made by a saw. (See figure 7, plate 2.)

Racks in the shape of round baskets are of late frequently made, having the appearance of the fourth part of a large globe. They are made of iron only, being too small for green fodder, as at present

manufactured, but deserve to be recommended for stables where no green fodder is used, because they are of a pleasing form, can easily be put up, and facilitate the operation of drawing out the fodder. (See figure 8, plate 2.)

This rack, manufactured at the founderies of Wirtemberg, weighs from forty to fifty pounds, and costs about three and a half cents a pound.

The material for racks is either wood or iron. In ladder-racks, the beams are made of oak wood, on account of their being gnawed, and the rundles of ash, on account of its great tenacity. Racks made either of wrought or cast-iron are recommended for their durability, being, this considered, not much more expensive than wooden ones, which require frequent repairs. Those made of cast-iron must be provided with much stronger rundles than those of wrought-iron; they will last almost forever, while in cast iron ones the rundles are easily broken off by being struck with the hay-fork, by an accidental blow from the head of a horse, or by the animal being fastened to a rundle, &c. The damages thus done can often hardly be repaired; it is, however, always best to insert new rundles of wrought iron.

*Arrangement for fastening the horses.*—In this, care should be taken that the horses may not step inside the halter-chains, or straps, which can be avoided by putting weights at the ends of the straps. The arrangement as indicated in figure 5 deserves special commendation, the weights being shoved up and down on a leading pole, serving at the same time as a foot for the crib. These weights usually run behind the wainscoting, below the cribs, or in a covered channel, applied in one of the corners of the stand. If straps are used for fastening, rollers of iron, brass, or hard wood, should be fixed at the point of the wainscoting where the straps are shoved up and down by the weights, for the purpose of sparing the leather. If the horse is to be tied with but one rope, it must be in the middle of the stand, and so as to allow him to lie down without lengthening the strap considerably, and thus giving occasion to step inside. A leading pole from the edge of the crib should be put up, with a movable ring, to which the short halter-strap should be buckled.