owner could nowhere be found, and no opportunity was afterward afforded until the close of the exhibition."

The other, offered by B. F. Field, of Milwaukie, Wisconsin, say the committee, is "a revolving plow and seeding machine, and is thus made: There is an outer slatted drum of iron, 4½ feet in diameter and 5 feet wide, made in three sections. Inside, on an eccentric shaft, are fixed three sets of 20 spades each, set 8 inches apart on 'spiders,' but all turning on one shaft. As they come in turn below, the spades project beyond the outer drum through the apertures, and the weight of the machine (2 tons) being thrown upon them, they enter the ground to the depth of 8 inches. The machine turning as it travels forward, the spades coming behind lift the earth as they emerge, and disturb its relative position as would a spade in the hands of a man, except that the soil is not inverted. Behind the spading apparatus, on the back part of the frame which surrounds the whole, is a row of ordinary drill sheaths to deposit the seed in the ground, which is fed to them by suitable hoppers with valves."

It is fair to conclude, from the facts thus brought together, that the subject of steam cultivation is attracting, both in England and America, the greatest attention. As yet, while we cannot admit that in either country any improvement has been tested, which so combines efficiency and economy as to give us assurance of its general adaptation, enough has been done to give us confidence that steam, especially on our broad prairies, must ere long render efficient aid to the farmer in tilling the soil.

CONSTRUCTION AND ARRANGEMENT OF HORSE STABLES.

(CONDENSED FROM DR. RUEFF, PROFESSOR AT HOHENHEIM, GERMANY.)

As most diseases of our domestic animals originate from the domestication to which they have been subjected, a condition often far removed from the natural one, it devolves as a principal duty upon the breeder and owner to take such care of them that this change of life, instead of an injurious, may have a beneficial result. Attention given to horses combines economical advantages, as feeding them in stables is not only a saving of fodder, but, under certain circumstances, also of labor.

The place where domestic animals are kept forms an essential consideration. In all countries, not sparsely settled, and therefore thoroughly cultivated, animals pass a great portion of the year, and even of every day, in the stable. This applies especially to horses, and easily explains the fact of more care and expense being bestowed on them than on any other domestic animals. Yet it is equally true that the labor and money expended for such stables are often insufficiently rewarded by the welfare of their occupants, because the construction

and arrangement are seldom executed with a degree of information corresponding to the importance of the matter, and for the special reason that the necessary knowledge of architecture and diet is rarely united in the builder.

In many cases, building a stable is left to the architect alone, who, when provided with ample means, is apt to indulge too much in his esthetic genius, often regardless of things appearing to be insignificant in themselves, though very important with respect to the principal object. Such things are often neglected, because of their being in contrast with his views of architectural beauty, and opposed to his plans. If, however, the means are limited, as generally happens, the building, notwithstanding the best wishes and knowledge, will often be erected in such a manner as will not answer even the most indispensable requirements.

On the other hand, the keeper of horses would not seem able of himself alone to arrange his buildings, as he has commonly no knowledge or experience in architecture. It would, therefore, always be best for the proprietor and the architect to exchange their ideas, and unite in carrying out such purposes. I have myself received numerous instructions from architects; had the experience of many years in keeping horses; examined plans of stables in various places and countries; and have been led by my position to a profound study of the diet; so that I entertain no fears of architects being dissatisfied at my undertaking to furnish some advice on the arrangement of stables. At the same time, I hope agriculturists and owners of horses will be pleased to receive such views as are based on my own experience.

In the first place, a stable should be protected from climatical influences, humidity, heat, cold, and winds. Again, it should afford security from all mechanical injuries, providing even for comfort, so that the animals, being left entirely undisturbed, may gather new strength for the performance of their services. Atmosphere, light, and heat, as the fundamental requirements of life, are entitled to the highest consideration in the arrangement of stables, and in their application they should be made capable of modification by man. The following points, individually, seem to deserve special attention.

Location.—In constructing a horse stable, the principal front should be to the west, so as not to be too much exposed either to the northern winds or the hot sun during the middle of the day. If, from want of room, any other locality must be selected, the stable should be protected from the above influences by the cultivation of trees, or shutters, blinds, &c. It would not be at all advantageous to locate a stable near a hill-side, or any other elevation, especially one consisting of a loose and porous soil, or, being of rock, if the layers should descend toward the stable, as, thus situated, the water will frequently find its way into the building; at any rate, the wall next the slope will be injured; and besides, such stables are, for the most part, humid and unhealthy. If such a position cannot be avoided, a trench should be dug around the stable at a distance of some four feet from the ground wall, the bottom of the trench to be always lower than the level of the stable floor; or a loam stamp may answer the purpose. These precautions are indispensable if a creek runs near, the surface of which is

always, or even for a time, higher than the bottom of the stable. Wherever the location is such that the droppings of the roof or other waters would cause a general wetness both of the ground and the bottom of the stable, drainage must be provided for.

Stables are often joined to other buildings; when to dwelling-houses, they have the advantage of being uniformly warmed. Though the warmth evaporating from horse stables during winter is agreeable, yet such a close proximity is not to be generally recommended, as the ceiling and windows of stables are not so constructed as to protect sufficiently the human inmates from ammoniacal vapors, and as the flies, always numerous in such situations, are very troublesome to man. Yet there should be an easy access from the dwelling-house to the stable, which would allow a convenient superintendence; for especially in rearing horses is the proverb applicable: "The eye of the master is worth as much as a sack of fodder." On farms, all kinds of draft animals are usually kept together in one stable, for the purpose of better overseeing them and of saving time in the distribution of labor. But there are many disadvantages in this practice, especially if the egress from the stable is one and the same for horses and draft oxen. Mutual injuries would result, and an undue cooling of the stables in winter, as oxen, on account of their slowness, require the doors to be kept open for a longer time. An additional reason will be found in the fact that horses require for their welfare a higher degree of temperature in the stable than oxen.

The ground.—The ground, on which the stable is to be erected, should be solid; especially avoiding peaty or marshy ground, otherwise the evaporations penetrating the flooring would fill the close rooms built above, and render the premises unhealthy. Loose ground absorbs too much urine, which, decomposing, will generate dangerous vapors of bad odor. In case of such improper foundation being unavoidable, solid stone pavements, tight gutters, spouts, and drains, must be provided.

External wall.—The inclosure is sometimes very imperfect. Stables on pastures are often without any walls, only a roof supported by columns being provided as a shelter from rain and the heat of the sun. If something better may be intended, these "sheltering huts" are merely closed with boards, and cribs and racks furnished for the purpose of feeding, if necessary. Nor is there much more solidity in stables constructed of hurdle-work. The mode of building of mud, or layers of stamped clay, has no claim to durability, as it affords no firm support for cribs and racks, which in horse stables require to be solid. Stables of beams and rafters, or the log-house structure, the interstices of which are filled with moss, will keep warm, yet, being perishable, they will not only be too expensive where timber is dear, but are also much exposed to the danger of fire.

I have seen a stable in the form of a log-house, with filled walls, which lasted thirty-one years. The pine logs, usually from three to four feet long, are inserted by means of tenons in the grooves of the perpendicular oak-columns and corner posts. To prevent the air from penetrating through the joinings, grooves are made, both on the upper and under side of the logs, and laths inserted in the grooves. The

logs employed are usually from six to seven inches in thickness. These wooden walls should be wainscoted, and as they are more liable to injury near the windows, they should be carefully protected there, by being covered with tin or painted with tar. Such buildings will be more durable if the roofs project to a great extent.

The best massive walls are those made of granite, limestone, and sandstone. The most suitable material for building stables is tufaceous limestone, resisting, in consequence of its porous quality, the rapid change of temperature, retaining firmly and for a long time its plastering, and being in many localities very cheap and easy of manufacture. In the majority of stable walls of stone, there is an essential evil, to be noticed in the generation of niter, in consequence of which not only the quality of the stone is impaired, but the stable is kept humid, on account of the hygroscopic qualities of the salt produced. The formation of niter is explained by the unavoidable decomposition of the excrement of animals, under the influence of humidity and warmth, promoted by the want of cleanliness, and the properties of the walls. Especially stones of a very porous nature, for instance, soft sandstones containing much clay, the yellow sandstone, porous limestone, limestone with organic remains, as shell lime in some localities, mortar and loam, containing kali, favor the generation of niter. Solid and polished limestones, as marble and granite, will not permit the formation of saltpeter, which is also prevented by smooth plastering. All varieties of stone, however, containing lime, kali, and magnesia, will, particularly when favorably influenced by the want of cleanliness, warmth and humidity, form saltpeter. But as this formation is confined to a certain distance from the surface of the ground and the wall, special regard must be had that the lower portions of the wall most exposed to humidity should be built of the best and densest material.

Ceilings.—Vaulted ceilings of brick or stone afford the greatest security against fire; they keep warm in winter and cool in summer; prevent the falling of filth from above, and permit no vapors to penetrate into the upper portion of the building; but on account of the side pressure caused by the vault, they require stronger walls, and are therefore expensive, both at the outset and in reparation. Besides, the vaults allow only imperfect ventilation. Wanting good and durable stones, the ceilings must be plastered, but on account of the different parts of the vaults not being uniformly warmed and moistened, such ceilings will soon crack and fall. Owing to this variation of temperature, vapors will collect on certain parts of the vault, and frequently fall in drops from the ceiling in winter, so that either some of the animals will be molested, or portions of the stable will always be damp and impure.

If it is intended to make a cheaper ceiling, it must yet be remembered that solidity is important, so that neither the dwellings that may be above the stables shall be molested by the vapors from below, nor that the beams and rafter shall thus be affected. If there is fodder stored away above the stables, it will also suffer from these vapors, and the filth, dust, and offal of hay falling through the ceiling will

render the skin of the horses impure, cause itching, and even in some cases, disease of the eyes.

Ceilings made with gypsum are unsuitable, as they will not last long; the wire and nails which support them rusting off, and allowing the material to drop, so that the animals will be dangerously excited, or even considerably injured. The advantages of plastered ceilings, in preventing vapors from penetrating, may also be secured by making them oblique, grooves being formed in the rafters, into which boards are obliquely inserted, so as to render them durable and easy of reparation. As better security against fire and the penetration of vapors, they may receive at the top a layer of mud mixed with gravel, or of loam with chopped straw. They will thus, also, retain a greater degree of warmth. The loam may be spread above to a height equal with the rafters, if the upper room is intended for storing away fodder; or there may be a common flooring, the space between which and the oblique ceiling to be filled with a non-conductor of heat, for instance: ashes, awns of barley and chaff. The filling up will keep warm, without being liable to catch fire, as many believe; for a fire may even be extinguished by means of chopped straw and chaff.

It should always be kept in view to prevent the beams of the ceilings from becoming rotten, a thing which so often happens. Some are of opinion that this object could be accomplished by shutting off the beams from the space of the stable by another ceiling, and thus protecting them. But it should be remembered that air and humidity are not so easy to be kept off, and that they will still penetrate through the joinings of the lower ceiling. The injurious consequences of these vapors will be more apparent when they are confined, as is indeed the case if the rafters are wainscoted both above and below. Should a current of air, however, be permitted to pass through, the ceiling would become too cold, and the vapors, precipitated too freely, would destroy the wainscoting. Were awns or chaffs, which would keep warm, put between, the air would still penetrate, thus moistening the beams; and in this case also, on account of insufficient change of air, they would be destroyed.

The worst method of constructing a ceiling is that of wainscoting by means of nails; it will soon be destroyed, the nails not being durable.

Others are of opinion that the beams could be better secured by leaving them perfectly free at the ceiling; they put on, therefore, a wainscoting above, or, for the sake of cheapness, small boards from one rafter to another, upon which they make a flooring of loam, or, still better, of gypsum. This kind of ceiling is very suitable when it is intended to keep fodder above the stable.

The stables should never be of such height as to prevent their being perfectly warmed. The destruction of the beams of the ceiling is merely caused by their becoming thoroughly moistened, a circumstance produced by too strong a cooling of the air saturated with vapors. Any stable in which the upper layers of atmosphere, being otherwise always the warmer, are rendered so cold that the watery vapors are precipitated, (in fluid form,) must, on the whole, be too cool. A

height of ten or eleven feet would seem to be most suitable where not more than six horses are kept.

The floor.—The part of the floor on which the horse stands may be constructed in a different manner from the passage-way. The former must be convenient for resting, and strong enough to bear the long-continued pressure of the body of the animal; it must also be so contrived as to prevent the accumulation of impurities.

As to the direction of the surface of this standing-place frequent mistakes are made. From over-care to secure the flowing off of the urine, the descent is often made too sloping, being five per cent., and even six per cent. Thus the horses are placed on a declivity, requiring a continual strain of the muscles of the limbs and back; the animals become tired in the stables, instead of resting; and their joints grow diseased, showing excrescences, barbels, defective positions, &c. Horses not shod, and colts, will, on a sloping floor, use to excess and wear away the front part of the hoof, while the proper standing parts are so little employed that they cannot sufficiently expand, thus becoming goat-hoofed and heel-bound, as indicated by too upright a position in the pasterns and fetlock, known as "goat-footed."

Whoever may observe horses in such situations, will find that, if possible, they choose an oblique direction, so as to gain a horizontal position for the length of their bodies. The care employed for the flowing off of the urine is, in most cases, not founded on perfect reason, because the males only would discharge their water within the stand, while the mares would wet the stand but little. Besides, with horses receiving no green fodder, this discharge is not so copious as to cause so much anxiety about drainage. At the same time, if there is always litter on hand, as it should be in a well-arranged stable, no water will flow from the stand.

A descent of the floor of from one to two per cent. is most suitable; horizontal stands not answering the system of the body of the horse, which is generally somewhat higher behind than in front; such construction, therefore, shoving the over-weight of the hind part toward the front or forepart of the animal. But in the passage-way a horizontal floor is the best, the objection being with regard to cleanliness; therefore, it may be a little arched, with a descent of from two to three per cent.

The material of the floor often consists merely of earth, or of loam beaten down; or it is a barn-floor, composed of loam mixed with iron scales and blood; again, a floor is made of gypsum, or four and a half parts of gravel with one of hydraulic lime.

There are, however, some floors unsuitable for stables. Loam mixed with sand, so often employed, is too liable to crumble. It would be better to use pure, uniform, and well-worked loam, which should be applied to a thickness of from 8 to 10 inches, and well beaten. A layer of hydraulic or black lime, two inches in height, on the moistened surface of the loam would contribute so much to the solidity of the floor that it would for a long time resist the tread of the horses.

Another good floor may be formed of seven parts of peat ashes finely sieved, and one of slaked lime. Both substances are m

water into a stiff dough, which is put on and stamped, either alone in a large quantity, or on a common loam floor in a more limited quantity.

As all these substances are slower in drying than gypsum, the surface requires to be frequently moistened in order to delay its drying until the inner layers shall have become perfectly united. In this manner the bursting and splitting of the mass may be obviated by repeated beating and stamping. If the materials for such floors are not well selected, or if the layer is too thin, they require frequent reparations, and are both expensive and troublesome.

They will not last long, in any situation; the action of the urine softens them, and they are loosened and broken by the shoes of the horses. They may only be applied in rather large running stables where young colts are kept, or, if at all in others, in the passage-way, where horses are neither too heavy, nor frequently brought in and out, and where there is great attention paid to cleanliness. Neither are those floors to be recommended for colt stables, where the colts are confined to one stand.

Macadamized floors, in inclosed spaces on which there is no driving of carriages, will never attain the same solidity and uniformity as is observed on open roads, and are, therefore, totally unfit for stables.

Common pavements are the most durable, and therefore the cheapest, the price, of course, depending not only on the locality, but also on the different kinds of stones to be used. Pavement, when used in the stand, has the disadvantage of more rapidly loosening and wearing out the horse shoes than on a floor made of wood. Some of the blocks, also, will inevitably sink, causing four-sided holes or pits, which are known to be dangerous. A pavement neglected and out of order will produce an unequal pressure, contusions of the body of the horse occupying the stand, &c.

For the same reason, those pavements made of rolling stones, and which so many see fit to recommend, should never be employed. It was thought that the sliding of the horses, so common in paved stands, could be prevented by employing stones not larger than a fist, but it is precisely on such, well-rounded and highly-arched as they are, that the foot is most liable to slide. Moreover, a great deal of dirt collects in the numerous deepenings and gutters between the stones. To a great extent the sliding may be obviated by allowing the floor in the stand but a very small descent, as above intimated, and by employing a material not too hard or rough; for instance, mixed sandstone. Granite would be better than shell-lime, Lias-lime, or Jura-lime, though sandstone wears off the horse shoes more rapidly than any other variety of stones.

The best pavement both for the stand and passage-way is made of double-burned bricks, which, after being closely laid with the high edge on a flat stratum of similar stones, are fastened with cement. All stone floors are, besides, liable to the objection of being a cold place of rest for the animals, and of subjecting them, under certain circumstances, to catching colds, a fact which will not so often occur on a wooden floor, that being a non-conductor of heat. If horses are obliged to rest on an uncovered floor, either standing or lying, their tired muscles and irritated feet will certainly sooner and better be relieved on a soft wooden floor than on a hard pavement. The disadvantages mentioned, however, in regard to the stone pavement may be removed, or at least modified, by a good litter, so that a stone floor may safely be recommended to all farmers provided with a sufficient supply of straw.

Wooden pavements are not at all suitable for floors in the stand, as the blocks, being often different in age and solidity, wear out unevenly, leaving pits, as in the stone pavements above mentioned. This material also readily absorbs the urine, which decomposes, producing bad odors in the stable and decay in the wood itself. It is generally suitable only where carefully kept dry, and may well be applied in the passage-way, for on such a pavement the tread of the horses is secure and pleasant to them; nor does it wear their shoes. The stratum below the wooden blocks ought to be porous, consisting, if possible, of sand, so that the liquids accidentally leaking through the joinings shall not collect below the wood; as a preventive, fine sand is sometimes swept and strewn into the joinings. The blocks should be from seven and a half to ten inches in height. In some large stables, this wooden pavement in the passage-way lasted over twenty-one years, without requiring any essential repairs.

Where, from the greater value of horses, it is the desire to arrange everything in the best way with regard to the health, strength, and even comfort, of the occupants of the stables, and where there is no scrupulous regard to expense, the floor of the stand is made of boards.

These stands may be constructed in different ways. The simplest method is to lay the boards directly on the sand or the natural ground. Another method consists in first laying down a floor of stone, bricks, or asphalt, which may conduct the liquids leaking from the wooden floor into the principal channel, either by a deepening on the lower surface, or by one or two gutters. On this water-tight floor, and in the direction of the length of the stand, three oaken beams are laid, upon which the boards are finally placed, so as to give them a secure foundation. All these board stands are somewhat expensive, as they require freqent repairs. It has been asked, which of the two methods is the most durable, or the best? To the hollow floors it is objected that they are dangerous to horses, whose hoofs might easier be caught in the holes often caused by the blocks decaying through, producing distortions of the limbs; or, it is feared the horse will stamp through the worn-out boards, and fracture his bones.

This stamping is not so dangerous as some may believe, for an attentive keeper will, from time to time, remove the defective boards; neither will an intelligent builder construct the drains on the lower floor of so great a descent that the foot would be injured by descending in them. Two gutters made lengthwise, or a single flat gutter, would be sufficient to carry off the urine leaking through the board stand. Their descent need not exceed from five to six per cent., while that of the board floor should be one to two per cent.; the hollow space below thus being but three inches at the deepest spot, provided the floor has not been unnecessarily raised by the beams. If there is a double gutter on the lower floor, the beams may be dispensed with, by construct-

ing the edges of the gutters and the backs between both gutters in so accurate a manner that the boards can be laid down flat and solid.

Some are of the opinion that boards laid down hollow are sooner liable to rot and to be destroyed, if they only become wet from below, and therefore they prefer laying them immediately on the ground; thus the whole board is always kept wet on all sides, as the water is continually coming up through the joinings. It is said that the wood is thus just as well preserved as if it were totally kept under water. But experience shows that the boards are less injured by decay than by shoes, hoofs, and sometimes even by the teeth of the horses. The hollow floors are always clean and dry, while boards laid directly on the ground are wet and dirty, spattering the hoofs, and often the legs, with manure water, which is the cause of rottenness of the frog and malanders. A board laid hollow, on an average, will keep for three years, so that the stand may still be said to be in good condition.

In laying these boards, provision should be made that they may easily be taken up again, either for changing or cleaning them. In changing them, the boards occupying the forepart of the stand, and not having been injured so much, may be substituted for those forming the back part, which are therefore more worn. They may be cleaned by taking up the front board and washing out the slab-floor below, pouring a bucketful of water through the opening made by the removal of the first board. This operation should take place every eight days. All the boards, however, should be taken up once every three months, so that the slab-floor and gutters may be thoroughly cleansed with broom and water.

Those boards lying immediately on the ground, being always wet, become softened, and are therefore apt to wear out faster by the feet of the horses than dry wood of the same quality. It seems to be improbable that wood continually saturated with and buried in manure water should be less liable to rot than wood accessible to air, and therefore, for the most part, in a dry condition. To facilitate the flow of urine through the boards, holes are made in them. This method, however, is unnecessary, and tends to accelerate the decay of the boards. The urine will find a way of itself through the joinings. The prominent part of the shoes of horses are sometimes caught in such holes, and thereby loosened; besides, perforated wood is more apt to absorb manure water.

In English stables, plates of cast-iron, perforated in the shape of a T, are sometimes used for the back part of the board floor to facilitate the flow of urine. Cast-iron floors will probably come into general use in stalls, because they are easy of removal and never entirely loose their value, as in the case with wood and stone.

As boards, when kept dry, are durable, they may be used for the floor of the forepart of the stall, and, closely joined, also for the back portion. With regard to the proper material, oak is the best, but the most costly. Beside, horses are more liable to slip on it than they would be on soft kinds of wood. If, however, but narrow boards are employed, or if four-cornered beams are laid across the ribs, so as to be changed four times, or whenever their surfaces may be worn out, the horses will not so often slip, on account of the many joinings.

Red fir resists moisture longer than white pine. Healthy and dry wood, which has not been cut during the running of the sap, (an important consideration in the building of stables,) should be procured.

From the preceding, it would seem that board floors are most suitable for light horses, whose weight will not produce much injury, and especially for mares, wetting at most the two last boards. In addition to this, it is thought that the use of horse shoes without points, as they are employed in Italy, France, and England, is especially favorable to the preservation of a wooden flooring.

In order to check the decay of wood in damp stables, it may be soaked before use in a solution of sublimate of mercury or kyanizing. This method, however, is expensive. Beside, attention may be called to the process patented by Bernett, consisting of muriate of zinc dissolved by iron vitriol and in water, in the proportion of one to six. Particular attention is called to the method proposed by Münzing, of soaking in sulphate of manganese. In consequence of the application of these saline liquors, the albumen of the wood, by which decay is principally generated, is made to coagulate, so that decomposition, as is the case in smoked meat, is very much delayed, if not altogether prevented.

In some stüds, the floors of the stalls are made of asphalt. Though these appear to be very clean, yet there are many disadvantages connected with them. Horses will crumble the material in a short time with their shoes, making its repair difficult, as special mechanics would be required. Horses not shod are liable to slip on this kind of floor, notwithstanding it may have been provided with notches. Yet, where not too costly, it may be recommended for stables of cattle.

It may be here mentioned that in England some stables have the floors of their stalls made of gutta percha and caoutchouc. This appears to be a luxurious experiment, no doubt agreeable and beneficial to the horses, but not easy to introduce generally.

Finally, the arrangement of stable floors deserves our full attention, as the expense of the building itself, the health of the animals, and cleanliness, are intimately connected with it.

Accommodation.—The space of a stable ought to be in proportion to the number of horses. The room required for horses of every size is nearly the same; it would be unreasonable to take a small race as a basis for the capacity of a stable, even if small animals were usually kept.

A single stand should be six feet wide and eleven long, being sixty-six square feet. Horses measuring from seventeen to eighteen hands are rare, and require a width of seven feet, while those measuring from twelve to fifteen may be content with five feet. If the stands are too narrow, there will be no convenience for cleaning or giving food, the animals cannot rest themselves, and wear out the narrow floor much sooner than they would a broad one. If the stall, however, be too broad, the horse will often place himself crosswise in his stand, be more apt to strike into the chains, and will find more occasion for kicking against the horses in his neighborhood.

Should there be but one row of stands in a stable, the width of the passage should be at least from six to seven feet, so as to allow the