

unless short manure is available and is applied as a top dressing, being worked into the soil with harrow and cultivator. In all these cases it is well to make calculations for re-seeding to grass and clover, sowing say three or four pounds of timothy with the wheat, or soon after, and a full seeding of clover in the spring, to fertilize the field by the growth of a clover crop, which is one of nature's best restorers of fertility.

Sow a Piece of Rape.

Every farmer who keeps sheep or young cattle will find it profitable to have a few acres of rape for late fall pasture. No crop will produce as much succulent feed or force young stock on in condition so rapidly. It may be sown profitably any time up to the middle of July, but the last week in June is the ideal time to sow. Clover sod may be plowed down after the early cut crop is removed, and will make a good preparation for rape, which may be sown on the level with a grain drill if a turnip drill that will sow on the level is not available, using the grass seed attachment of the drill, closing part of the holes and running the seed down the rubber tubes, which may be slanted to carry it to the hoes in use, sowing two or three drills at a time from 20 to 26 inches apart as the division of the hoes on the drill will admit. Cultivate a few times with the horse hoe to keep down weeds and promote the rapid growth of the crop.

VETERINARY.

The Housing of Live Stock with Regard to Health.

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My attention has recently been turned to a subject of great interest to farmers and stock-owners, namely, the proper housing of live stock during the long winter months of our severe northern climate. The importance of the great dairy and live stock industry justifies the application thereto of the best results of scientific experiment and structural skill in the erection of suitable buildings for the shelter and care of the animals upon the output of which the profits of the industry depends. Regard for economy and convenience, the smallest possible pecuniary outlay with the best facilities for attention to the stock, looking to the maximum of results with the minimum of investment and labor, has led to the combination of barn and stable in one building. While this combination has many commendable features, it has also serious disadvantages which are liable to imperceptibly defeat the prime object of the investment and render the enterprise unprofitable through an unthrifty condition of the stock from overcrowding, the results of which are that the circulatory system of the animals is impaired, digestion is only partially performed, vital stamina is lowered, and the resistant power to disease is diminished. These results become definite in the poor showing of the farmer's ledger at the end of the year.

Several things have tended to bring this subject prominently to my notice during the past few months, among which may be mentioned the inspection of some unhealthy cattle which I found housed in a faulty barn, the perusal of various plans for barn and stable buildings which have appeared in this journal, and a suggestion contained in a letter by Mr. Arthur Johnston, of Greenwood, Ont., which appeared in the issue of Jan. 15th, commendatory of my article on Tubercular Infection in the issue of Jan. 1st, which, with other like favorable comments, I desire gratefully to acknowledge.

Mr. Johnston was more than right in saying a good word for light and ventilation in stables, and it is to the unfolding of this suggestion by showing how essential these are from a sanitary and economic point of view that I now address myself. If rational methods of barn architecture conduce at once to the maintenance of the highest standard of health and the most economic and profitable care of stock, there is surely sufficient inducement to the consideration of this subject.

SUNLIGHT A VALUABLE GERM DESTROYER.

The benefits of light justify the trite statement that you cannot have too much of it. It is not generally known, though it ought to be, that the best, cheapest and most easily applied germ-destroyer is bright, hot, dry sunlight. The most thrifty microbes cannot live in its presence more than a few hours, while in a dark, dank place they will thrive, and it would seem that the whole wicked brood love darkness rather than sunlight because of their evil deeds. Put in, therefore, all the windows you can, and if your animals "laugh and grow fat" from the increased pleasure brought into their monotonous existence, as probably they will, you will not object.

The principal interest of the subject, however, centers in the matter of accommodation and ventilation or the provision of the necessary space so that the animals may have an adequate supply of pure air, for it is in this respect that the gravest sins against nature's laws are committed and the greatest need of improvement in our barn buildings obtains.

The natural life for stock is, of course, out in the green field where everything conduces to health. But the necessity of winter sheltering confronts us, with the artificial conditions it involves, and this has to be considered, with provision for the

prevention of disease and the maintenance of health under these conditions as factors in the problem. The solution of this problem lies in the application of the principles of animal hygiene to barn structure, and let not the farmer be afraid of the application of science to this matter, for true science is essentially practicable.

In what follows I shall use data supplied by that eminent authority, Fred Smith, F. R. C. V. S., in his work on Veterinary Hygiene. Dr. Smith stands at the head of the Army Veterinary Department of Great Britain, and is consultant in the building of military stabling. His statements may be accepted with the greatest confidence, and my calculations and deductions will be based upon them.

For the maintenance of health the exhalation of carbonic acid gas from the lungs or arising from excrement must not accumulate in excess of .2 per 1,000 volumes. The gas ammonia is also largely present in the cattle stable, and that is detrimental to the system generally and to the eyes in particular. Besides the poisonous effect of these gases in themselves, if an atmosphere befouled by their presence has to be breathed by stock any microbic infection present has a good opportunity to get in its fine work. The average amount of carbonic acid gas exhalation is 6.5 cubic feet per head per hour for animals weighing 1,000 lbs. A supply of 32,500 cubic feet of pure air per head per hour is therefore necessary in order to the maintenance of a healthy standard for animals of this weight. Reducing this to the average weight grade of the stock contemplated, we have 32,000 cubic feet per head per hour as the necessary supply.

AN ILLUSTRATION.

To illustrate my argument I will ask my readers to study carefully, with the accompanying description, the plans for a "Well-contrived Barn" in the FARMER'S ADVOCATE of March 1st, page 102. These plans are probably better than the average of actual barns, and are referred to not for special admiration, but to give concrete effect to the discussion.

In the description the height of the masonry of the main building, which alone we are discussing, is given as nine feet. Allowing one foot for joisting, I think I am safe in assuming that the height of the basement story is certainly not more than ten feet. We have, therefore, the following dimensions:

40 x 62 x 10.....	24,800 cubic feet.
Deducting:	
15 cubic feet per head for 34 head of cattle.....	510
Root bin, 6 1/2 x 21 x 4.....	546
Fittings (estimated).....	144
	— 1,200

Available air space..... 23,600 cubic feet.

Dividing this result by 34, the number of head of cattle for which fixtures are placed, gives 694.4, or say, roughly, 700 cubic feet of available air space per head as the most liberal construction the plan admits of.

Without ventilation such space would be contaminated with carbonic acid gas to the extent of 9.3 per 1,000 volumes in one hour. Alarming as this appears, the vitiation can be remedied if sufficiently frequent changes of air can be made so as to dilute or remove these poisonous exhalations. In our northern climate, however, the condition of cold is a factor to be contended with, and the necessary introductions of pure air to maintain the health standard of .2 per 1,000 volumes would be not less than 45 times per hour, or about once every minute and a half. With such frequent changes of air the temperature of the stable would be practically the same as that outside, the extreme cold making great demands upon the feeding simply to maintain body heat. Yet the failure to effect these changes of air where by the cubic contents of stablespace per capita of stock they are necessary is precisely the reason why cattle will come out from the pretentious new barn in a less healthy condition than from the old straw-chinked stable with its unintentional provision for ventilation, the same care in other respects being exercised in each.

THE ASSOCIATED MANURE SHED CONDEMNED.

The manure shed in the plans under review cannot but be regarded with disfavor. Any receptacle for the temporary deposit and rehandling of excrement so situated would only increase the trouble. In such a place and under such conditions the liberation of ammonia would be very considerable, and that of carbonic acid gas would be from .9 to 3.0 per 1,000 volumes; and if heating of manure ensues bacterial spores will fill the surrounding air and be carried to the adjacent stables.

The fact is, there are fixtures for double the number of cattle that in cubic dimensions the building is adequate for when conditioned by the necessity of protection from the extreme cold of our rigorous winters. Seventeen is the utmost number of stock which such a stable would properly accommodate. It might, however, be made to accommodate twenty-five head by certain alterations which are perhaps possible. At least 1,500 cubic feet of space per head must be provided, though 2,000 feet would not be any too much in our climate. This would require that the stable basement be made 13 feet clear of floor and the total area of the manure shed be added, the space of which could then be advantageously used as a driveway to remove the stable clearings every

morning. The root bin will also have to be left out. These changes would yield the following result:

Basement, 40 x 62 x 13.....	32,240
Manure shed, 16 1/2 x 30 x 13.....	7,800
	40,040 cubic feet.
Less—	
15 cubic feet per head for 25 animals.....	375
Fittings (reduced estimate).....	100
	475

Available air space..... 39,565 cubic feet.

Dividing this by 25, the number of stock we now propose to provide for, we have 1,582 1/2 cubic feet per head. With this amount of space per head the more rational number of twenty changes of air per hour only would be necessary instead of 45 required under the previous conditions, while if 2,000 cubic feet per head were provided only sixteen changes of air per hour would be needed.

A VENTILATION SCHEME SET FORTH.

The best mode of ventilation now claims our attention. I regret that the absence of side elevation or sectional view in the plans we are reviewing leaves us without precise knowledge of the means of ventilation employed therein. I can therefore only state what I conceive to be necessary and serviceable.

Adjustable windows are, as a rule, unsatisfactory on account of their fragile nature and the tendency of frames to swell under the influence of moisture. Windows should be used only for the access of light, and should be made double or provided with storm sashes for the saving of heat; and, indeed, every part of the building should be made as cold-proof as possible, since every unit of heat thus conserved may be reckoned as a bank account on which we draw for the purchase of the pure air necessary for health, and the balance of which means economy in feeding and increased productivity. Neither can doors be relied upon for ventilation, though useful for occasional flushing, since it is during the long nights when prudence tells us that they should be locked that the greatest need obtains for a regular change of air. A draft is in nowise necessary in order to perfect ventilation, which consists essentially in the dilution of vitiated air by the gradual perfusion of pure air, or simply by the diffusive power of the gasses.

In vertical ventilation shafts, as ordinarily constructed, there is great difficulty in maintaining the up draft, from the tendency of the foul air to have only a slight amount of buoyancy, and to balance in the shaft, becoming when cooled of equal weight with the surrounding medium in the upper part of the shaft. The only mode of construction I have found successful is making them two feet square, with smooth boards on the inside to avoid friction, dividing the shaft vertically and cornerwise from end to end, and having it project two feet from the roof, with side openings for the four compartments and a suitable covering. Thus constructed, the shaft becomes a combined up and down ventilator, changing its up and down draft according to the direction of the wind. Shafts thus constructed work admirably in small stables; but in stables on the scale we are considering horizontal ventilators placed between joists, with openings on the sides of the building, and conveyors to carry the fresh air one-fourth across the building, give better results.

A word must be said concerning the area of ventilators. In the plans being reviewed I notice there are in the cattle department three shafts, the combined area of which is fifteen square feet, which would not begin to effect the changes of air required by the number of stock contemplated for the space. For twenty-five head of stock twenty square feet of ventilator area on each side (for in and out draft) would be required, assuming an average wind rate of eight miles an hour. Slides would, of course, have to be provided for use in case of special draft; and in order that only pure air be admitted, without which the whole purpose of the provision would be defeated, it is absolutely necessary that manure be not deposited under the openings of the ventilators.

PRESERVE FEED FROM CONTAMINATION.

In regard to the feed storage upstairs, though very convenient, unless it be well protected from the gasses ascending from the stables by the tightest fittings and covered chutes, the feed will not be improved in quality, and may become seriously contaminated by microbic foes.

In conclusion, I would say that stock-owners should realize that light and pure air are just as necessary as foods; that nature supplies us with an unlimited quantity of these free of charge; that windows and ventilators are all that is necessary to give access to these important vital agents; and that space is an absolute stable requirement of the latitude in which we live; and also that the extra expense involved in a good building is very little when spread over a fifty years' term of usefulness. The tendency of the time is towards the large, pretentious barn, which has so many valuable features to commend it, and makes such a show on the farm; but I believe that the best results will be obtained in the single-storied stable, with moderately-pitched roof, and separate building for feed storage, which, being adjacent to the stable, will allow of the feed being mechanically distributed to the stock by means of travelling conveyors.

Animals, we know, can adapt themselves to a great variety of adverse circumstances, but the