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Forage Plants for South Dakota : Silos and Silage

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February, 1897.

Bulletin 51.

U. S.
EXPERIMENT STATION,
SOUTH DAKOTA.



IN CONNECTION WITH THE
SOUTH DAKOTA AGRICULTURAL COLLEGE.

Forage Plants for South Dakota.

SILOS AND SILAGE.

Department of Agriculture.

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Any farmer of the state can have the Bulletins of this Station free upon application to the Director.

Forage Plants for South Dakota.

E. C. CHILCOTT, Agriculturist.

The natural advantages of the state of South Dakota as a stock country have long been recognized. Our range beef and mutton is regarded as second to none in its class. Our wool has earned an enviable reputation in all of the wool centers of America. And last in order of development, but by no means least in importance, our dairy products have established a name for themselves among the very best on this continent. All of these achievements have been won almost entirely without the aid of cultivated grains and grasses. Our native prairie grasses have, in nearly all cases, been the principal, and in many instances, the only food of our stock.

In some parts of our state the system which has produced such satisfactory results in the past can be continued for a considerable time to come, with but slight modifications, while in other portions, particularly in the older and more thickly settled districts, conditions have so changed, and are still changing, that a very different system must eventually be instituted. In these localities, our native grasses, which have been the basis of nearly all of our success in the past, are fast disappearing and being replaced by inferior introduced grasses and worthless weeds. The causes which have brought about this undesirable, but inevitable result are not hard to discover. Overstocking and tramping, which seem almost unavoidable during some portions of the season, if enough stock be kept to utilize the feed during flush times, is one of the most potent, and also the most difficult to avoid. For if only such an amount of stock is kept during flush feed as can subsist upon the pasture, without overstocking during the dry parts of the season, the grass will make such a rank growth during the spring and early summer that stock will not eat it during the dry periods. Another, only slightly less potent, but more universal factor, and one still less amenable to any known methods of prevention, is the gradual migration of hardy, worthless, weedy grasses and plants from the older to the newer settled portions of the country. This

migration is greatly accelerated by the agency of man. Weed seeds are scattered along railroads and highways, and are introduced by grain shipped in from neighboring states for seed. These weed seeds first find lodgment along railroad embankments and in cultivated fields, but they soon spread to the prairies and there crowd out the less hardy but more valuable native grasses; and we have as yet been unable to find any certain practical remedy for the very unsatisfactory condition of many of our pastures. We confidently believe, however, that the important problem of restoring native pastures will eventually be solved. But in the meantime we must resort to some expedient to provide food for our stock, where the native grasses have failed. The only feasible one yet discovered is to provide forage crops of some kind to supplement the failing supply of pasture.

Another reason why the subject of forage plants is of great importance to the farmers of the state, at this time, is that our state is rapidly filling up, and as land becomes more valuable, a more intensive system of farming is becoming desirable and more profitable than the old one, which was at the best only a compromise between "ranching" and farming. Our farmers are learning that there is often more profit in keeping a few good animals in high condition upon a comparatively small tract of land than there is in allowing a large number of inferior animals to "rustle" over an extensive range.

In order to pursue this intensive system profitably it is necessary that stock intended for the block be kept growing continuously from the time of birth until ready for market. Dairy cows should be so fed that there will be no check during the period of lactation, and that period should extend as near to the time of parturition as is consistent with the health of the animal.

Wool sheep should be so fed as to produce an even staple, and young lambs, intended either for the block or the flock, should be provided with some soft, succulent food at weaning time, when the pasture grasses have dried up and they are deprived of the accustomed supply of their mother's milk.

In the dairy and stock raising districts of the Eastern and Central states they have learned that forage crops, roots or silage are, one or all of them, necessary for success.

It is true that some of our farmers claim that our native grasses are so much superior to the cultivated grasses of the east that we can successfully compete with eastern dairymen without the aid of forage, roots or silage. And these claims are not without foundation. It is a well known fact that our native grasses cure upon the ground as soon as the dry weather of August and September sets in, and before they have been injured by frosts; and that a fine quality of well cured hay, superior to the average meadow hay of eastern states, can be cut upon our prairies at any time after August before the ground is covered with snow. As it frequently happens that we do not have enough snow at any one time during the winter to prevent stock from grazing, it ought not to be difficult to understand why we can truthfully say that "our stock can range the year round and we can cut hay upon our prairies from August until March." There are, however, some years, and especially this year, when this statement cannot be substantiated.

While it is unquestionably true that we have the advantage of our eastern competitors in the quality of our native grasses, it is also true that they have the advantage of us in the length of time during which stock can obtain succulent food. Such being the case, it seems that it is even more important that we should supply forage, roots and silage for late summer, fall and winter feeding, than it is for the eastern dairyman or stockman to make a similar provision.

Having, as we believe, shown the importance of the subject, we will now proceed to the discussion of some of the various forage, root and silage crops that have been grown at this Station.

GENERAL PLAN OF EXPERIMENT.

This work has been under way during portions of four seasons, but unfortunately it has been so interrupted that it is impossible to give exact results for each of the four seasons. But although in some instances the exact results of but a single year are given, these results are consistent with those of other years and the conclusions drawn are based upon the general results of four years' experience, and are therefore of much greater value than if based upon one year's work.

In experiments with various forage plants the usual plan has been to put in one-quarter acre plats of each species or variety

under identically the same conditions, to treat them alike during the season, and to weigh the product at the end of the season. Besides the quarter-acre plats we have generally raised larger tracts of many of the crops to furnish feed for our stock, and in the following discussions we shall often give results obtained from these fields as well as those from our experimental plats.

INDIAN CORN.

This is unquestionably the most valuable forage plant yet discovered, adapted as it is to such a wide range of conditions, and possessing, as it does, the quality of producing such a large yield of valuable feed at a low cost of production.

There are other plants that seem able to fill certain wants, but there is none that is so well known and universally used from the Atlantic to the Pacific and from North Dakota to Texas as Indian corn. Volumes have been written upon the use of corn as a forage crop. Hundreds of tests have been made to determine the best variety, quantity of seed, manner of planting, harvesting, preserving, and manner of feeding until it would seem as though everyone engaged in farming, or familiar with agricultural literature, must appreciate the value of Indian corn as a forage crop, and have a fair idea as to the best method of cultivation, etc. This does not, however, seem to be the case. There are hundreds of farmers in the state who are attempting to make a success of stockraising and dairying, who utterly ignore this valuable plant as a forage crop. In no state in the Union have the farmers yet succeeded in making a success of dairying until they have recognized the value of "sowed corn," both for soiling during the summer and fall and for winter food, either as dry fodder or as silage. And I do not believe that Dakota farmers will be able to dispense with it.

Considerable quantities of corn for forage, or "sowed corn" have been raised at the Station every year for the dairy stock. A large number of varieties have been tested and different methods of planting and different quantities of seed have been tried. Yields ranging from three tons to twenty-five tons of green fodder per acre have been obtained. On the Hunter farm, in the season of 1896 the yield of Salzer's Superior fodder corn was 25.6 tons of green, or 19.2 tons of dry fodder per acre. Early Adams fodder corn yielded 17.28 tons of green, or

9.6 tons of dry fodder per acre. These results were obtained under irrigation. As good results, however, have been had on the Station farm, without irrigation. While no attempt will be made at this point (See Table I.) to go into the details of the experiments, the following are some of the conclusions arrived at:

VARIETIES.—Every seedman's new catalogue contains the names of new "varieties" of fodder corn recommended as far superior to anything yet introduced in that line. In some instances the names are new but the corn is usually the same as that sold the previous year under some other name. Then again there are those who attempt to keep their seed corn pure, and possibly they succeed, so far as the admixture of any other variety is concerned, but corn is so susceptible to the influence of environment that as soon as the conditions under which it is raised are changed, the characteristics change, and we therefore often meet with samples of corn differing very widely in their general characteristics that are known by the same name, so that on the whole very little dependence can be placed upon the mere name of a variety.

For the purpose of this article we can divide the corn usually grown for fodder into three classes, as follows:

1st. Large leafy Southern dent which never reaches maturity in this latitude and seldom forms ears, but furnishes a large amount of fodder.

2nd. Medium Dent which will form ears under favorable conditions, and may nearly reach maturity under the most favorable conditions.

3rd. Small early Dent, which will ripen under average conditions in this latitude.

In selecting a variety, and also choosing the method of planting, the purpose for which the crop is intended and the facilities for harvesting and handling should be taken into consideration.

When the forage is to be cut early, for soiling, or when the stalks are to be preserved for dry fodder, the large Southern variety (Class 1) should be selected, and the seeding should be so thick that the stalks will not become coarse. The most satisfactory method of planting tried here is to use a 2-horse corn planter with drill attachment, making the rows just one-half the usual distance apart, i. e., with a 3ft.-8in. planter make

the rows 22 inches apart, which can be done by "straddling" every other row, and sowing about $1\frac{1}{2}$ bu. of seed per acre.

If care is taken to make the rows perfectly straight and a uniform distance apart, the corn can be cultivated with a small drag-tooth, one-horse cultivator. The ground should be dragged as soon as planted and at frequent intervals until the corn has reached a height of six or eight inches, when one or two cultivations will be all that is necessary to carry it to a stage when it will completely shade the ground and make any further cultivation unnecessary. Corn sown in this way can be cut with a mowing machine or with a binder, and the stalks will be fine enough so that cattle will eat most of them.

If the product is intended for silage, varieties should be selected from Class 2, or preferably from Class 3, and the planting and the cultivation should be about the same as though the corn were to be husked. It has been found that the nutritive value of the product of a given area is greatest when the planting is thick enough and the variety such that the ears will, at least, reach the "roasting ear," and preferably the glazing stage by the time the corn is cut.

The most economical way of harvesting such corn is with a corn harvester and binder, several of which are now on the market. There are also several corn harvesters which cut the corn but require the binding to be done by hand, the binders riding on the harvester. Most of these work well and are a great improvement upon the old method of cutting by hand, and where only a small quantity of corn is grown, it is probable that many farmers will find these machines better suited to their wants than the larger and much more expensive harvesters and binders.

SORGHUMS.

Sorghums can be divided into two classes—saccharine and non-saccharine. This division is purely arbitrary and simply means that those varieties which are classed as saccharine contain enough sugar in their juices to make them profitable as a syrup or sugar producing plant, while in those classed as non-saccharine, sugar does not occur in sufficient quantity and in proper form to make them of value for those purposes. All kinds of sorghums contain considerable quantities of sugar in their juices.

SACCHARINE SORGHUMS.

AMBER CANE.—Among the saccharine sorghums, probably Early Amber is best adapted to the requirements of a forage plant for this latitude, as it has been grown more extensively and longer in the northern states than most other varieties and has therefore become better acclimated than the more southern varieties.

Next to Indian corn, Amber Cane is probably the most valuable forage plant that can be grown. It requires much the same soil and treatment as Indian corn, except that it should be sown with a grain drill instead of a corn planter. It may be sown in rows 28 to 35 inches apart by allowing every fourth or fifth hopper to feed, or it can be sown the same as oats or wheat. When a thick growth of fine stalks, which can be cut with a mower and raked and handled like hay, is desired, a bushel of seed to an acre is not too much. But where the largest yield of nutritive matter is desired for silage, thin sowing, in rows 28 to 35 inches apart, with thorough cultivation, will give the best results.

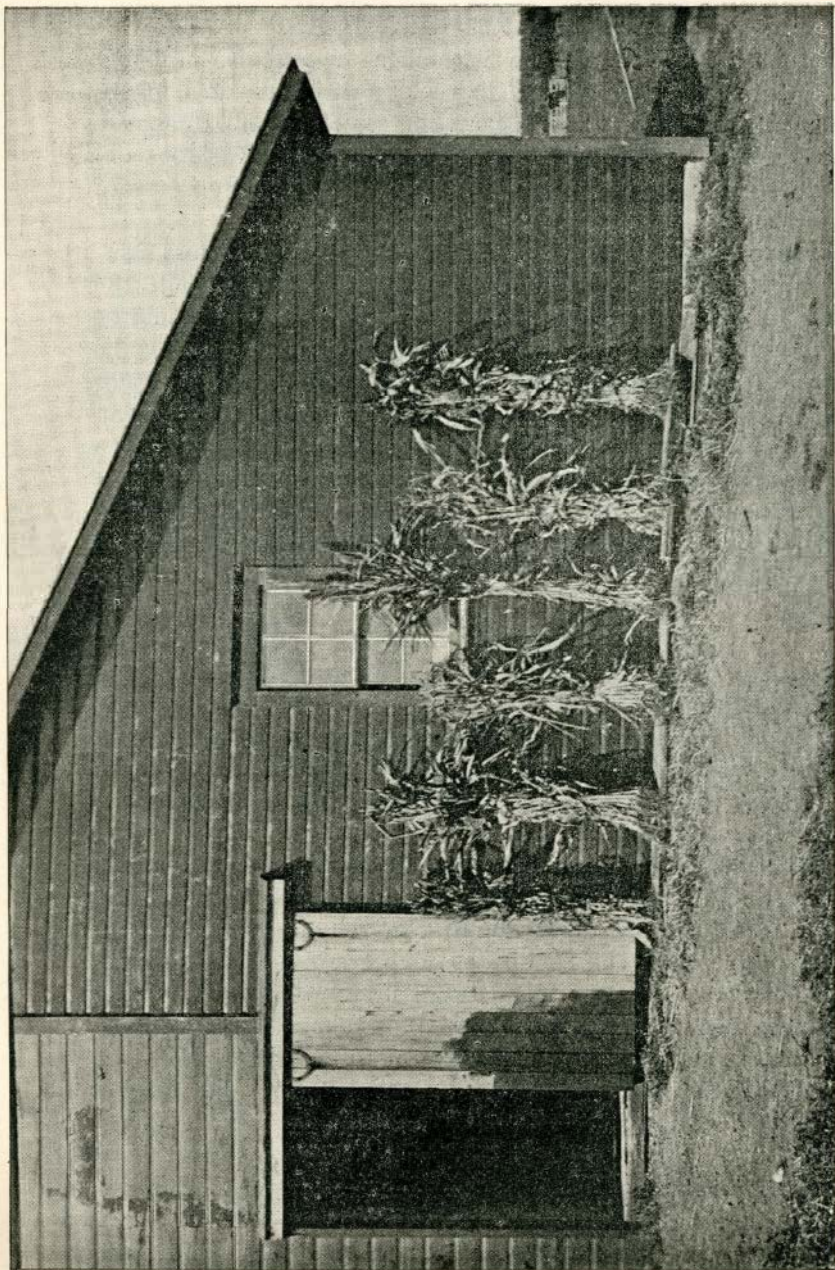
NON-SACCHARINE SORGHUMS.

KAFFIR CORN, JERUSALEM CORN, BROWN DOURA CORN and YELLOW MIL• MAIZE are best known among the non-saccharine sorghums. All of these have been grown at the Station for several years, but in no instance have any of them proved equal to Indian corn or Amber cane, when the cost of production is taken into consideration.

The principal obstacle to the profitable production of these sorghums is the fact that they germinate very slowly, and make a very feeble growth during the first month after planting. In the spring of 1896 the conditions for germination and growth were very favorable, but upon June 16, twenty-four days after planting, they had only made a weak and spindling growth of about two inches, while two varieties of Indian corn, planted at the same time and under the same conditions, had made a strong and vigorous growth of about six inches. This habit of growth on the part of these sorghums makes hand hoeing and weeding necessary, in order to keep down the weeds, while the Indian corn can be tended with a drag and cultivator.

In the drier and warmer parts of Kansas these sorghums, particularly Red Kaffir corn and Jerusalem corn, are raised in

PLATE I.



1 2 3 4 5 6

large quantities, both for forage and for the grain, and by many are considered equal, or superior to Indian corn, for both these purposes. But experiments conducted at this Station, so far, do not indicate that any of them are as well adapted to our conditions as Indian corn or Amber cane. It may be, however, that in time a variety will be developed suited to our conditions.

EXPERIMENTS WITH INDIAN CORN AND SORGHUMS FOR SILAGE.

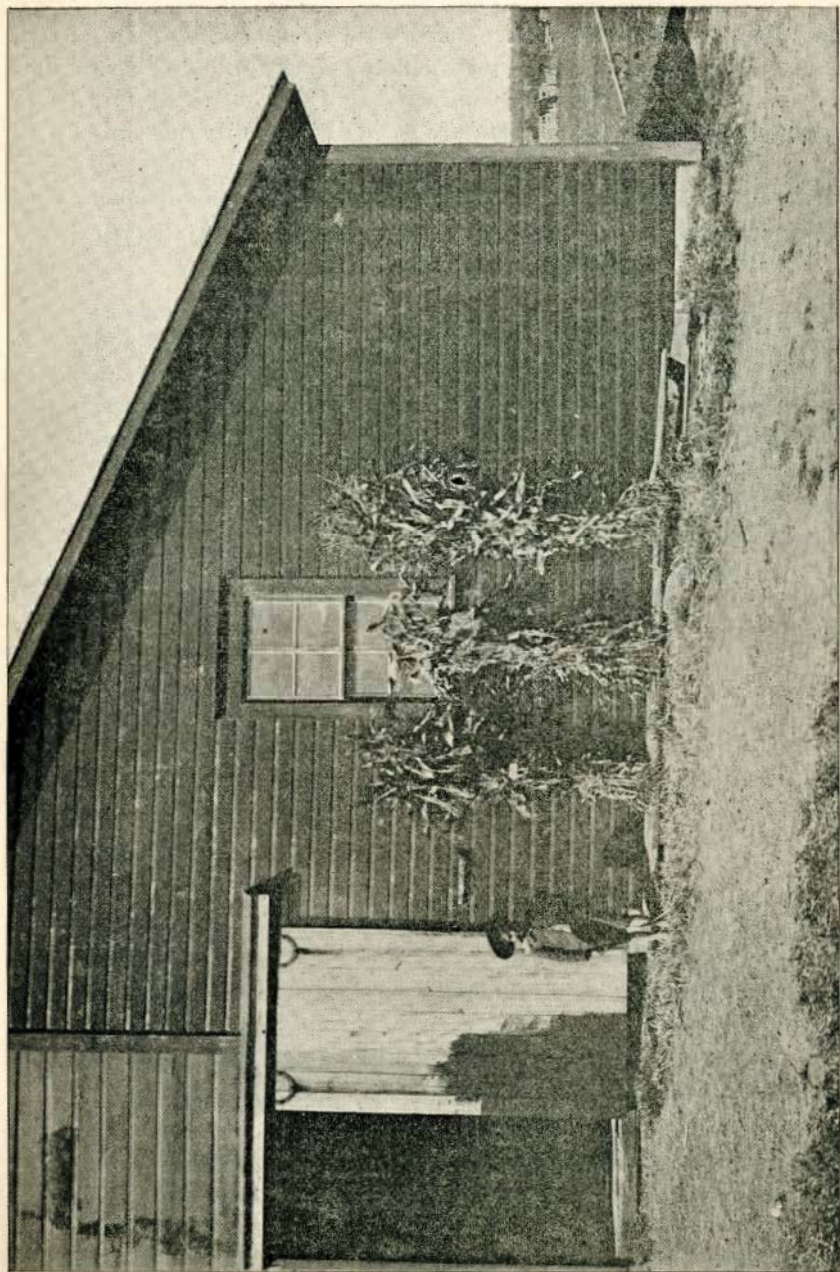
In the spring of 1896, six plats were prepared and sown to INDIAN CORN, AMBER CANE, KAFFIR CORN, JERUSALEM CORN and MILO MAIZE, as indicated in Table I. The sowing was done on May 22nd, with a "New Model" garden drill, set as follows: For Kaffir corn, Jerusalem corn and Milo maize, set for parsnips; for Indian corn, set for peas; for Amber cane, set for carrots. A good stand was obtained in every instance, and the plats all received thorough cultivation during the season, and were cut August 26th, with a corn harvester, the produce weighed and put into the silo. The following, Table I and Plate I, will show the results obtained:

TABLE I.

No. of figure—Plate I.	Name.	Pounds seed per plat.	Weight of green produce per plat.	Yield per acre.—Tons.
Fig. 1	Kaffir Corn.....	4	4075	8.15
Fig. 2	Jerusalem Corn.....	3	3675	5.35
Fig. 3	Indian Corn—"Pride of the North".....	13	4500	9.00
Fig. 4	Amber Cane.....	1	6850	13.70
Fig. 5	Indian Corn—"Salzer's Earliest Fodder".....	10½	3750	7.10
Fig. 6	Yellow Milo Maize.....	2½	4700	9.4

As will be seen from the foregoing table, Amber cane yielded the most feed by weight, Jerusalem corn the least, and Indian corn about an average between the two. If we consider the weight of the fodder alone, regardless of its feeding value, Amber cane is much the most profitable to raise, but when we take into consideration the fact that both of the varieties of Indian corn were small, native Dents, and that they had reached a much more advanced stage of maturity than any of

PLATE II.



KAFFIR CORN. JERUSALEM CORN. INDIAN CORN.

the sorghums tested, and that they were well eared with corn in the "roasting ear" stage, while the seed of the sorghums was very immature, it is probable that the real value of the corn was equal to, or even greater than, that of any of the sorghums. Had some large, coarse growing, leafy southern variety of corn been grown, it is fair to assume from the results of former trials that a yield fully equal to that of the Amber cane would have been obtained, but the quality would have been inferior to the forage obtained from the smaller Dent.

COMPARATIVE VALUE OF KAFFIR CORN, JERUSALEM CORN AND INDIAN CORN
RAISED FOR SEED.

May 21st, 1896, three plats of one-quarter acre each were planted respectively to Kaffir corn, Jerusalem corn and Indian corn in rows 3 ft, 8 in. apart, and hills 3 ft. apart in the rows. The Indian corn was of the "Pride of the North" variety. The Kaffir corn was the Red Kaffir corn, from The John A. Salzer Seed Co., and the Jerusalem corn came from the same seedsman. The plats were all kept in thorough cultivation during the season, and a good stand and growth were obtained. (See Plate II.) The plats were all cut upon September 18th, and it was our intention to thresh out the sorghum seed and to husk and shell the corn in order to obtain a comparison between the crops of seed; but it was found that the blackbirds had done so much damage that it was impossible to obtain any reliable results as to the yields. This much, however, was discovered: The Indian corn showed a good crop of well matured ears while the seed of both the Kaffir corn and Jerusalem corn was very immature and much shrunken.

RAPE.

Rape has been grown at this Station for the last five years, and we have never failed to obtain a good stand and crop, when sown in drills. We have raised some good crops from broadcast seeding, but if the weather is at all dry at the time of seeding, the surface soil, to the depth of an inch or two, is likely to become so dry during the preparation of the seed bed that the seed, which should not be covered more than an inch, will not germinate. We have usually adopted the practice of sowing with a garden drill, in rows about two feet apart, using

about three pounds of seed per acre. When sown in this way it can be cultivated until it grows large enough to shade the ground and keep the weeds down. This plan works well for small fields, but for large ones the common grain drill can be used, and if the ground is clean, it will not be necessary to have the rows far enough apart for cultivation but all the shoes can be allowed to seed. If, however, the ground is foul, it will be advisable to stop up some of the feed hoppers so as to make the rows 28 to 30 inches apart. In using a grain drill not less than five pounds of seed per acre should be used, and a little experimenting will be necessary in order to discover how to set the drill. Rape can be sown any time after danger of severe frosts in the spring is over, and until September 1st. Severe frosts will injure the young plants when they first appear, but do not seriously affect the more mature leaves. In this respect it resembles cabbage, to which it is closely related. For providing feed during the summer and fall, a succession of sowings should be made at intervals of about two weeks, beginning as early in the spring as practicable and continuing at intervals of about two weeks until September 1st, which is about as late as it can be sown.

Rape can either be fed off in the field by sheep, cattle or hogs, or it can be cut and used as a soiling crop. It is especially valuable as a food for young lambs at weaning time. Seed can be obtained from any seedsman at a reasonable price, and we believe that if every farmer in the state who is raising stock would try a small patch, many of these would find that it is worthy of a permanent place among the farm crops. Early Essex and Victoria are the only varieties yet tried at this Station, and both are equally good.

OATS AND PEAS.

Mixed oats and peas have been grown very extensively, both in this country and in Europe, for soiling, forage, and as a substitute for hay; and the produce is highly esteemed for all these purposes. This crop should be sown on rich, well prepared soil as early in the spring as the land can be gotten into proper condition. We have found a press drill the best implement for sowing as it insures deep covering of seed. The amount of seed required per acre varies with varying conditions.

In the spring of 1895, a field, which had been plowed deeply

the previous year, and well manured during the winter, was sown to oats and peas, mixed at the rate of 2 bu. of peas to $1\frac{1}{2}$ bu. of oats. Through a mistake in setting the drill this mixture was sown at the rate of $4\frac{1}{4}$ bu. per acre. The season was a favorable one and we cut from this field $11\frac{1}{2}$ tons of green fodder per acre. In 1896, a yield of $7\frac{1}{4}$ tons of green fodder per acre was obtained when 3 bu. per acre of an equal mixture of peas and oats were used. In 1896, a yield of $1\frac{1}{2}$ tons of dry hay per acre was obtained from a seeding of 2 bu. per acre, of a mixture of 1 bu. of peas and $\frac{3}{4}$ bu. of oats. This is the lightest yield obtained, but it is not believed that the light seeding was the controlling factor, as the oats were badly rusted.

From our experience at the Station, it is believed that on rich soil, 4 bu. per acre of a mixture of 2 bu. of peas to $1\frac{1}{2}$ bu. of oats will not be found too much. On a poorer soil 3 bu. per acre of such a mixture would give better results. In selecting seed for this purpose, an early variety of peas and a late variety of oats should be selected, otherwise the oats will ripen before the peas reach the best stage for cutting. The best stage for cutting for hay is when the oats are in the milk stage and the first pods are beginning to fill in the peas. Hay made from this mixture, when cut at this stage, is readily eaten by all kinds of stock, and has a high nutritive value. It also makes a fine feed cut green for soiling, or it can be pastured off.

SAND VETCHES.

Sand vetches have been grown at this Station for several years, and have invariably given a good yield of excellent forage, whether sown alone or mixed with oats. The only serious obstacle to their extensive use as a hay or forage crop seems to be the high price of the seed and the fact, that as yet, we have been unable to raise any seed, although the plants have grown very well and blossomed very freely. This failure to produce seed is not yet fully understood, but will be thoroughly investigated during the coming season,

When mixed with oats, which is the best way when the crop is to be cut for hay, owing to the low, vine-like habit of the vetch, the seed should be mixed at the rate of 2 bu. of vetch to 1 bu. of oats, and sown with a common seed drill, set to sow $2\frac{1}{2}$ bu. of wheat, which will sow about 120 pounds of the mixture per acre.

When vetches are sown alone, the drill should be set to sow two bushels of wheat; it will then sow about 120 pounds of vetch seed per acre.

In 1895, the yield when sown with oats (April 29th, and cut July 8th.) as described above, was 9 tons and 440 pounds per acre of green forage.

In 1896 the yield was 3360 pounds of dry hay per acre, but the general yield was very much lessened by rust attacking the oats.

In 1896 the yield of green forage from vetches sown alone was five tons per acre, which, when dried into hay, amounted to 2532 pounds of dry hay of excellent quality. The plat was sown May 21st, and was not cut until September 16th, although the vetches had reached a height of twelve inches and had begun to blossom July 1st. Had they been cut about July 15, they could, undoubtedly, have been cut a second time before October 1st, and would have made a much better showing as to yield. They would have afforded a large amount of pasturage, as they remained green and in blossom, until severe freezing weather set in.

RYE.

In many states rye, either winter or spring, is considered one of the most valuable soiling and forage crops; and it would be very profitable could it be grown here, especially to provide early spring and summer feed. We have not, however, as yet, had much success with it at this Station. When it has been sown in the fall the ground has usually been so dry that the seed has not germinated well; when sown in the spring and summer, it has been so badly rusted as to render it worthless for feed.

Last fall (1896) the ground was unusually wet and a good stand of winter rye was obtained, but it is still too early to determine how it has stood the winter.

On May 25th, 1896, two plats were sown, one to St. Johns rye, and one to winter rye. A fine stand was obtained with both and a splendid growth was made, especially by the St. John's rye, until about the 20th of June, when both plats were attacked with rust and the foliage completely destroyed. The same results were obtained at the Mellette irrigated farm. We do not wish to be understood as declaring that either winter rye

or St. John's rye is a total failure as a forage plant in this state. We simply give the results of our somewhat limited experience and still hope that both may prove valuable, as they undoubtedly will, if enough moisture can be had to germinate the seed in the fall, or if rust does not destroy them when sown in the spring,

SPURRY.

Giant spurry has been successfully grown at this Station, and while it is not considered as an especially valuable forage plant, it has some characteristics which may render it of value to the farmers of the state, under certain conditions. Among these are the following:

1. It grows very rapidly and will yield two or three cuttings in a season.
2. It stands drouth well.
3. It seeds very abundantly, and therefore the seed can be grown very cheaply.

On the other hand, it is a very low growing plant, with a tendency to lodge down in a mat, which renders it very difficult to cut. When cut and dried for hay it becomes very dry and brittle and many of the leaves drop off when handled.

In 1895, one cutting, seven weeks after sowing, yielded 18,680 pounds green, or 2,920 pounds dry feed per acre.

As a pasture plant it has not been sufficiently tested to enable us to give an opinion; but it is to be hoped that it may prove of value for that purpose. The seed is very small and is best sown broadcast, either with a grass seeder or by hand, and should be only very lightly covered with a roller or plank.

MILLET.

Millet is so generally grown, and its merits are so universally recognized by the farmers of the State that it seems hardly necessary to recommend its cultivation here. On the other hand, a bulletin on forage plants would be incomplete without some mention of so valuable a plant.

Although millet has been grown chiefly as a hay crop in the past, it is equally good for green fodder and has been very successfully used at this Station to furnish pasturage during the dry months, when the pasture grass has failed. When used for this purpose, the pasture should be divided into two or more

parts, so that when one portion is being fed off the other will be growing.

There are many varieties of millet but "Common" millet has given best satisfaction here when grown for forage or hay. As a grain crop, Broom Corn millet is best.

Millet can be sown at any time during May or June when the soil is in proper condition to insure prompt and even germination. One-half bushel of seed per acre is about the proper quantity.

It is believed that much loss in the feeding value of the hay is caused by allowing the millet to become too ripe before cutting. There is also much less danger of bad effects to animals from eating early cut millet than there is when the seed is allowed to ripen before cutting.

The best time to cut millet for hay is when a majority of the heads have distinctly appeared. We have fed large quantities of millet hay here to all kinds of stock and have never experienced any bad effects from it. We have, however, always cut our millet early, as recommended above.

SOME FAILURES.

Among those forage plants which have been tried at this Station and have not proved sufficiently successful to warrant us in recommending them to the farmers of this State are the following:

SACCLINE, about which so much was heard a few years ago and so little within the last year, has been tried and proved a failure.

In the spring of 1895 six roots and a quantity of seed were obtained. The roots were set out in a hot bed May 4th; two of them died, the other four were set out in the field July 18th. having attained a height of from 18 to 40 inches. They were watered and carefully tended but made little further growth and the next spring they were all dead.

The seed was sown in flats April 10th to 11th. Most of the seed germinated and the plants were transplanted to 3-inch pots June 3rd and 4th. On June 25th and 26th the plants were set out in the field. About half died; the other half grew fairly well during the season, but none survived the winter.

COW PEAS and **SOJA BEANS** have both been tried repeatedly but have never given results that would indicate that they are

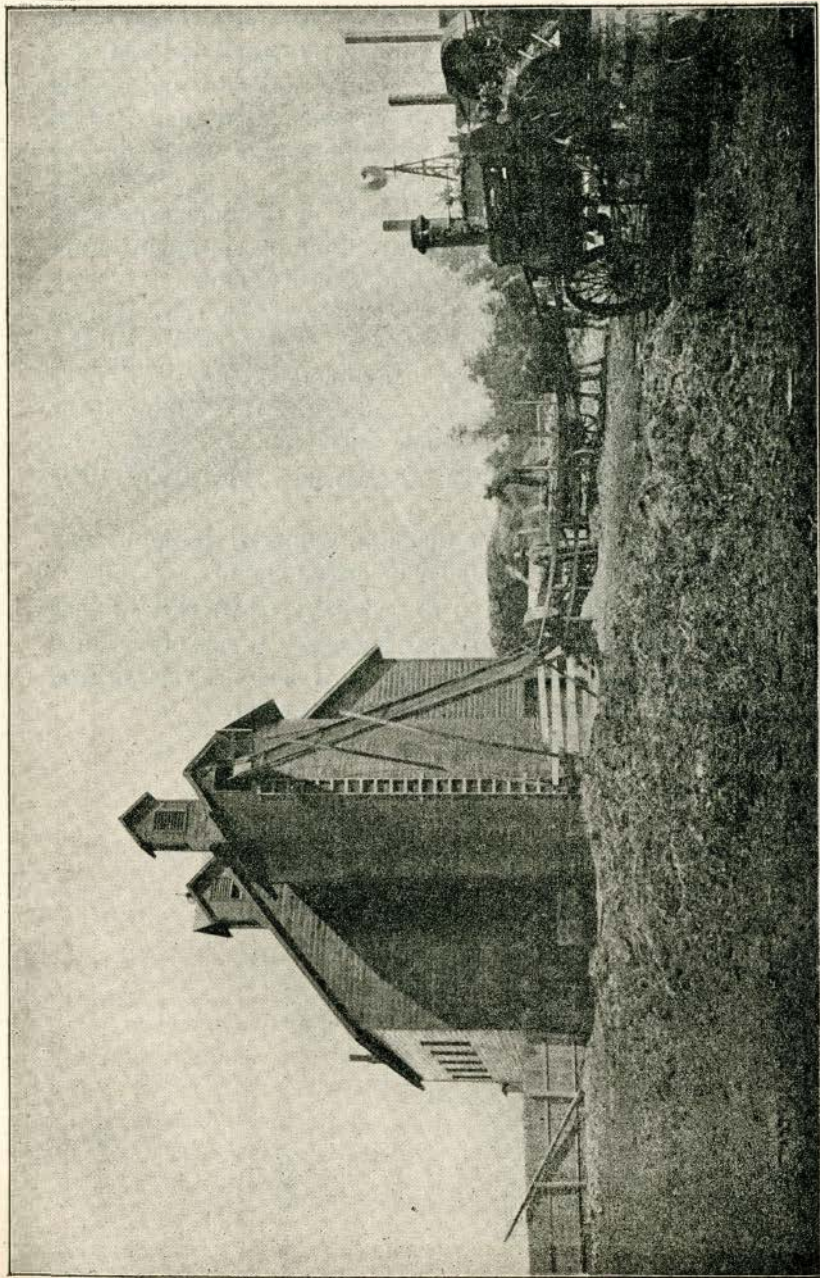
adapted to our conditions. The plants are quite tender when they first appear and are easily injured by frost, wind and rain storms. They will not ripen seed and the foliage is not readily eaten by cattle until they become accustomed to them. Both cow peas and Soja beans are valuable forage plants for the southern states and have been recommended by several of the stations as suitable for green manuring in the northern states. We believe, however, that there are other plants much better adapted to both of these purposes for South Dakota.

MELILOTUS (also called Bokhara Clover, Sweet Clover), SERADELLA, SANFOIN (also called Asperset or Esparcet); and LUPINES, are all coarse, woody, leguminous plants. All have grown fairly well here, but when a good growth is obtained the stalks are generally so coarse and woody and the leaves so inclined to drop off, when they are dry, that they are of little value as hay.

It is believed that some of them, particularly Melilotus, may prove valuable for plowing under for green manure.

FLAT PEA OR EVERLASTING PEA, (*Lathyrus silvestris*.) has been tried repeatedly but without success. It has often failed to germinate, and when it has grown it has been weak and spindling and has never survived the first winter.

PLATE III.



THE STATION SILO.

Silos and Silage.

Silos and silage have long since passed beyond the "fad" stage. The time has been within the last twenty years when many enthusiastic advocates of silage made most extravagant claims, such, as for instance, that by the use of the silo the nutritive value of a crop could be doubled, or in other words, that double the amount of stock could be kept upon a given area, where the fodder was converted into silage.

On the other hand there were those who claimed just as strongly that silos were not only expensive and impracticable, but that silage was unfit for any kind of stock, and that the feeding of it would eventually result in the death of the animals eating it, from derangements of the digestive organs and that it would be impossible to make first-class dairy products from the milk of animals fed upon silage, which they declared was decaying vegetable matter, and totally unfit for food. All these, and many more statements equally foolish, were made on both sides of the question, until, as is usually the case, conservative men have learned that the enthusiasts on both sides were wrong, and that the truth lies about half way between the statements made for and against the system.

It is now generally admitted that the converting of green forage into silage adds nothing to its nutritive value; it simply preserves it, much as canning preserves green fruit. It is also admitted that silage, when properly prepared, is a wholesome food for all kinds of stock; and owing to its succulent nature it is particularly desirable for the dairy cattle and young growing animals. The need of some kind of succulent food for this class of stock is pretty generally admitted. Whether this succulent food can best be provided during our long, dry falls and cold winters in the form of silage or as roots must be decided by each dairyman for himself. Then again the question as to whether green forage crops can be most economically preserved in the form of silage, or by converting them into dry fodder, is

one the solution of which will be largely governed by the varying conditions of different localities and farms.

In order to ascertain the estimation in which silos are held by the leading dairymen of the United States and Canada. F. D. Coburn, secretary of the Kansas State Board of Agriculture* sent out a circular to representative dairymen in the United States and Canada, asking, among others, the following questions:

“What is the smallest number of dairy cows for which a farmer would be justified in building a silo; and do you consider the silo a necessity to the most profitable dairying?”

Sixteen answers were obtained to the first part of the question, and the average of all the answers was approximately 14 cows. Throwing out the answer of Jones, a Kansas dairyman, who put the number of cows at fifty, while the highest number mentioned by anyone else was twenty, we have an average of 11.2-15.

Nineteen dairymen answered the second part of the question, of which eight were decidedly of the opinion that a silo was a necessity. Six stated that while a silo was not an “absolute necessity,” that it was “highly desirable,” “the cheapest way of preserving green fodder,” “silage is one of the best of foods,” “I would not keep a dairy without one,” etc., etc.

Five expressed it as their opinion, that a silo was not a necessity. But one (Haecker, of Minnesota.) says he prefers to feed silage, simply because of its convenience.

The other four, who thought a silo was not a necessity in Kansas, all base their opinion upon the fact that all kinds of coarse fodder must always be plentiful and cheap in Kansas where such an amount of corn is produced, and but little attention is paid to the stalks.

I think we can safely make the statement, that it is the consensus of opinion of the representative dairymen of the northern United States and Canada, that a dairyman having no more than twelve cows can afford to build a silo, and that the silo is a “necessity to the most profitable dairying.”

As to the relative importance of the silo in South Dakota, as compared with other dairy states, as already set forth in the introduction, we believe that, owing to the much shorter period

* Tenth Biennial Report Kas. State Board of Agriculture, p. 228-229.

here, as compared with the eastern states, during which cattle can get succulent food from our pastures, owing to the curing of our grasses on the ground, and the long and more severe winters, as compared with Kansas, the necessity of the silo in dairy husbandry in South Dakota is even greater than in most of the other dairy states.

SILOS AND HOW TO BUILD THEM.—Granting that a silo is a necessity for the most profitable dairying, the next question that presents itself is what kind of a silo should be built. This is a much more complicated one than the one as to the advisability of building a silo at all.

No one questions the statement that a dairyman should provide warm, dry, well ventilated, comfortable stables for his stock. How to accomplish this to the best advantage, with the available means, is a problem which nearly every man must solve for himself. There are hundreds of stables in our state that fulfill all of the above requirements, that have been built from sods, logs, straw or poles, and represent very little outlay except the labor needed for the construction. Many of these come very near being the very best that could be built under the circumstances and conditions. At the same time, they are not at all the kind of stables that anyone would build under more favorable conditions.

This silo problem is very much like the stable problem, which the farmers of this state have solved so ingeniously, and so well and in such a variety of ways; and it must and will be met and solved in much the same way just as soon as our dairymen recognize the necessity of the silo.

THE ESSENTIALS OF A SILO, are that it be an enclosure, with walls nearly air tight, and of sufficient strength to resist the great lateral pressure of a mass of green silage. A roof is desirable to protect the silage from the weather, but is not absolutely essential. A covering of hay will usually turn any storm likely to occur after the silo is filled and until it is empty.

THE SIZE OF THE SILO should be such that it will contain one cubic foot of silage for each animal for each day of the feeding period. For instance, a silo for 30 cows, 6 months, (180 days), should contain $30 \times 180 = 5400$ cubic feet.

THE SHAPE OF THE SILO is of less importance than some sup-

pose. It should be borne in mind, however, that a round silo will hold more in proportion to its wall surface than any other form, a square comes next. The walls of a round silo can also be made of very much lighter material than a square one, and still have the necessary strength. The higher the silo in proportion to its diameter, within reasonable limits, the more compactly will the silage settle; and consequently, the greater will be the capacity, and the better will the silage keep.

The silo should be so arranged that not more than five square feet of feeding surface for each cow will be exposed at any one time; otherwise the silage, being so long exposed to the air, is likely to spoil. If the diameter of the silo is too great to conform to this rule the silo should be divided by a partition, which may be of a single thickness of boards, as it has been found that the lateral pressure disappears very soon after the silage once settles.

THE COST OF THE SILO varies between wide limits. The following description of a silo built at the Colorado station* will give an idea of how cheaply a silo can be built:

A silo was built on the College Farm the past season to ascertain how cheaply one could be made, and whether such a cheap affair would answer equally as well as the more expensive for the preserving and feeding of ensilage. Silos in the east are not built belowground because during half of the year the ground is saturated with water. No such trouble need interfere with the Colorado farmer. There are many places where a hole 8 to 12 feet deep would remain dry the whole year, and such a spot on the college farm was selected for the silo. It is on a slight slope, and a hole 21 feet square and 8 feet deep was dug out with a plow and scraper. The only handwork necessary was in the corners and on the sides. The dirt was dumped as near as possible to the upper end and the two sides.

Inside this hole a 2x6 sill was laid on the ground, 2x6 studding 12 feet long erected, and a 2x6 plate put on the top. This framework was then sheathed on the inside with a single thickness of unmatched, unplanned, rough boards, such as can be bought almost anywhere in the State for \$12 per M.

The inside was lined with a single thickness of tarred building paper held in place by perpendicular slats. The floor was made by wetting and tramping the clay at the bottom, while the stars of Heaven made an excellent and very cheap roof. * * * The ensilage put into the college silo last fall is now being fed out and proves to have kept well. When the silo was full it was covered with a small amount of straw and the dirt from the sides thrown onto the top to form a layer six inches thick. Both the straw and dirt were soaked with water to make them pack tighter. When the silo was opened from two to three inches of ensilage were found to be spoiled, under the straw and in the corners for a little greater depth. Below this the ensilage has kept remarkably well. No eastern silo with double walls of matched lumber could produce any better.

* Bull. No. 30, Colorado Ex. Sta.

Mr. Joseph E. Gould, of Uxbridge, Ontario, secretary of Northern Ontario Farmers' Institute, in an article which appeared in "Farming" for September, 1896, recommends the building of stave silos, in the following words:

"In advocating the building of these silos at institute meetings, I have pointed out that, while a round silo is unquestionably the best, a stave silo is not the best kind of a round silo. Inasmuch, however, as they answer all practical purposes, I have urged the building of them, as they can be built so cheaply as to come within the reach of almost every farmer. They are practically invaluable to tenants whose landlords will not help them, as they can be taken down in two hours and taken away when the tenants term expires. A 60-ton silo can be built for \$40 to \$60, depending on the price of the lumber in the locality. My large silo—140 tons—cost about \$75. * * * So great is my faith in them that I would build a new one for each crop, if it were necessary, rather than be without one."

These stave silos are simply round tanks, without top or bottom, made of 2-inch lumber, from 6 to 10 inches wide, jointed but not beveled, with hoops of $\frac{3}{4}$ -inch iron provided with suitable blocks for tightening. They may be built upon a stone foundation, or set upon the surface of the ground without any foundation, or they may be let into the ground for a few feet. Where no foundation is provided, it will be necessary to puddle the clay around the bottom of the staves to exclude the air. The hoops should be placed about four feet apart, and it may be found necessary to loosen them somewhat when the staves begin to swell from the effects of the wet silage, in order to prevent them from bursting. Mr. Gould says, although the silage froze to a depth of several inches on the inside of this silo, he did not believe that the silage was materially injured thereby, as his stock ate it readily after it was thawed out, and seemed to suffer no bad effects from it.

None of these stave silos, so far as we are aware, have been tried in this state, but, if they are as much of a success in the cold climate of northern Ontario as Mr. Gould claims, we see no reason why they may not be profitably used in South Dakota. It is hoped that a trial of them can be made at this Station during the coming season.

Although it is possible that neither of the above described silos are adapted to our conditions, I think that enough has been said to show that a successful silo can be built without

great expense, just as a comfortable stable can be erected from very crude materials.

THE STATION SILO.

During the season of 1896, a silo was constructed at this Station, under the supervision of the writer. While no claim is made that this is the best silo that could be built for the money, yet the matter received the careful consideration of the writer, and after examining the plans and specifications of a large number of silos, described in Station bulletins and other publications, the following plans were adopted. There is but little that is entirely new or original about this silo, but it is believed that a description of it may be of some use to those intending to build.

This silo (See Plate III) is 16 feet in diameter and 30 feet from sill to plate, and has a capacity of 125 tons of green fodder, as it comes from the field. It is built at the west end of the dairy barn, and there is a chute, 4x4 feet, between it and the barn. This chute extends the entire height of the silo and terminates in a ventilator about six feet above the ridge of the dairy barn. Into this chute the four feeding doors of the silo open. There are also two doors from the dairy barn opening into it, one at the bottom from the feeding alley which runs between the two rows of mangers, and one from the floor above. This chute makes it very convenient feeding the silage as it can be thrown from any of the doors into the chute and it will drop very close to the place where it is needed for feeding. A car and tramway could be put in at a small cost, so arranged that the silage would drop into the car when it was run into the chute, and when it was filled the silage could be distributed by running the car along in front of the feeding mangers. This chute also acts as a ventilator for the cow stables. In giving bill of materials and estimating the cost of the silo this chute is not included.

THE FOUNDATION is of native boulders laid in Yankton cement. The wall is $3\frac{1}{2}$ feet high and 2 feet thick at the base, narrowing to about 8 inches at the top (See Plate IV.) The mortar used for laying the wall was made by mixing one-third Yankton cement and two-thirds sand, while that used for the plastering after the stone work was finished was mixed two-fifths cement and three-fifths sand. The bottom was made by

putting in a layer, 8 inches deep, of broken stone, and pouring over it cement mixed very thin so that it would fill all the open spaces between the stones. After this had hardened the whole inside surface was plastered over with mortar so as to entirely cover all the stone work.

THE SILL, was made by cutting 2x4 pine into sections 2 feet and 1 inch long at the outer points, and cut at $7^{\circ} 30'$ angle. Forty-eight of these were required to make a double sill. They were spiked together with 20 d. nails, so as to break joints, as shown in Plate V.

THE STUDDINGS are 2x4, 16 feet long, lapped 2 feet and nailed together, making a total length of 30 feet between sill and

PLATE IV.

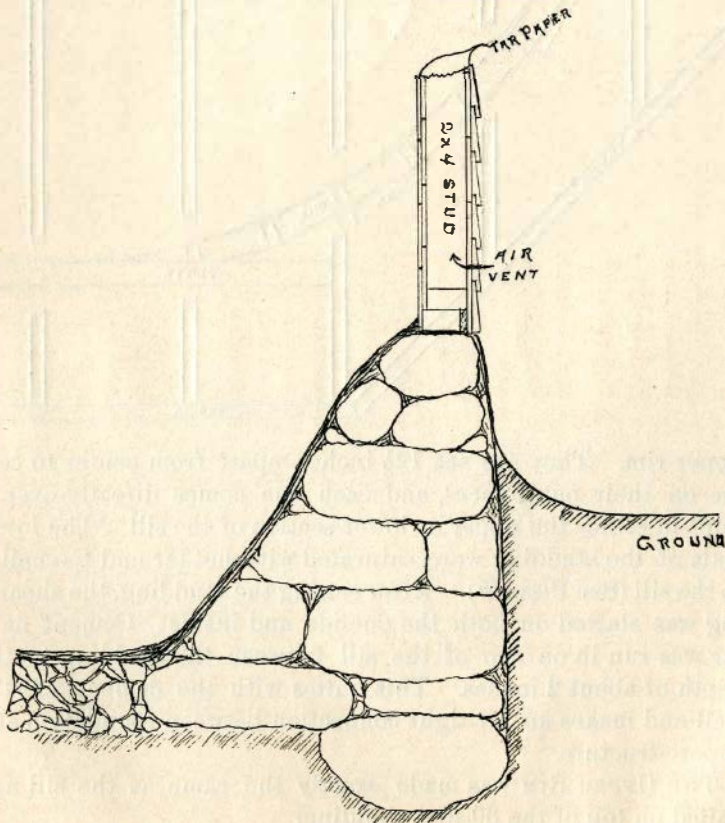
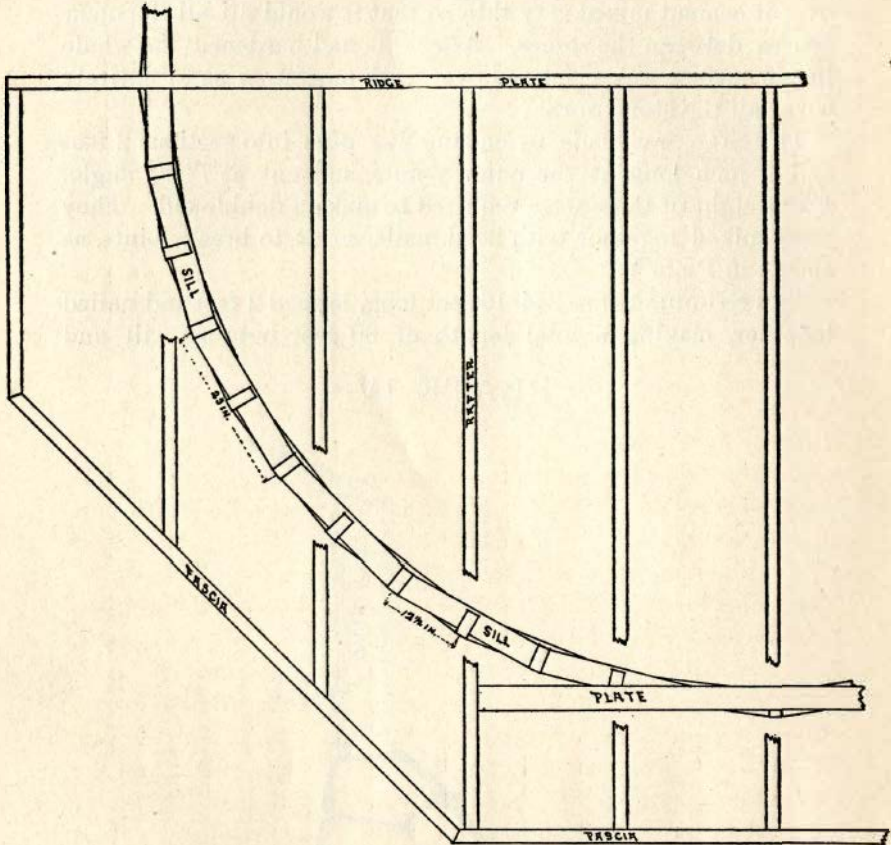


PLATE V.



upper rim. They are set $12\frac{1}{2}$ inches apart from center to center on their outer faces, and each one comes directly over a joint in either the upper or lower section of the sill. The lower ends of the studding were saturated with hot tar and toe-nailed to the sill (See Plate V). After setting the studding, the sheathing was started on both the outside and inside. Cement mortar was run in on top of the sill between the studding to the depth of about 2 inches. This unites with the cement of the wall and makes an air-tight connection between foundation and super-structure.

THE UPPER RIM was made exactly the same as the sill and nailed on top of the 30-foot studding.

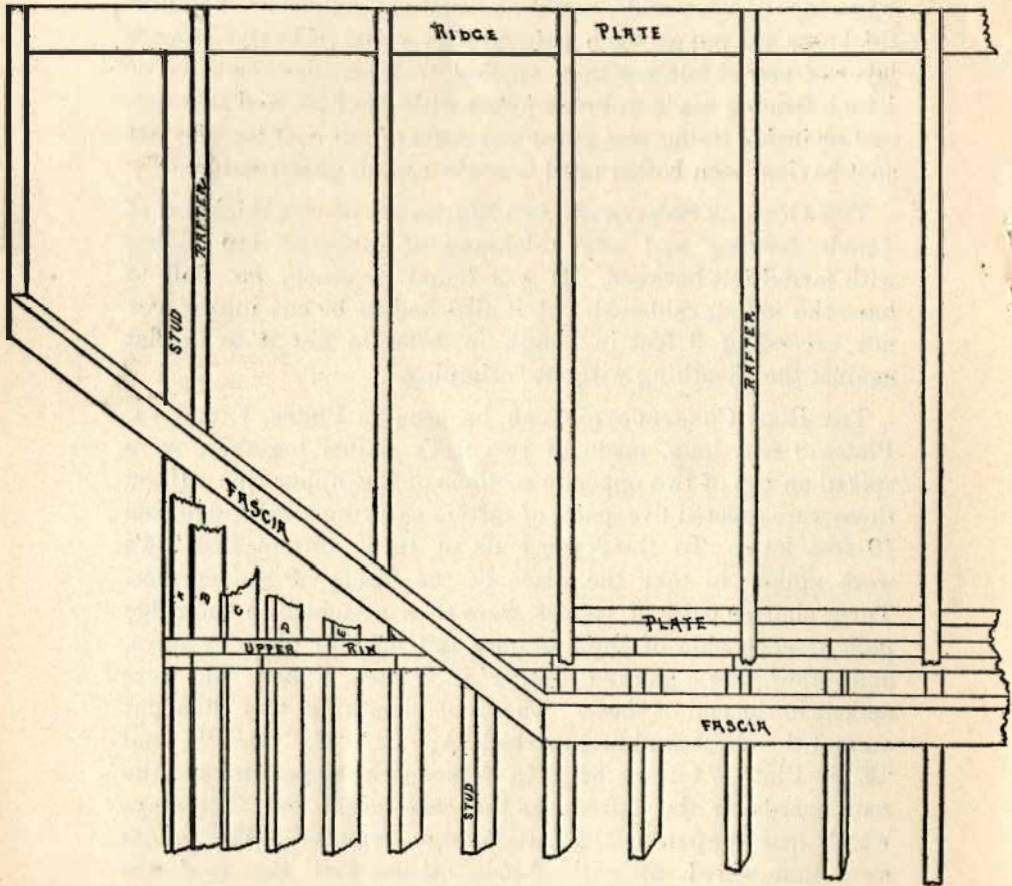
THE INSIDE LINING is made of two thicknesses of $\frac{1}{2}$ -inch No. 1 fencing, 6 inches wide, neither planed nor matched. The first thickness was put on, then painted with a coat of hot coal tar, a layer of tarred felt was then applied, then another thickness of $\frac{1}{2}$ -inch fencing made to break joints with the first, and this second or inside lining was given two coats of hot coal tar, the last coat having been boiled until it made a hard, glossy surface.

THE OUTSIDE SHEATHING AND SIDING are of one thickness of $\frac{1}{2}$ -inch fencing and one thickness of rabbeted lap siding with tarred felt between. It was found necessary not only to have the siding rabbeted, but it also had to be cut into pieces not exceeding 8 feet in length in order to get it to lie flat against the sheathing without "crimping."

THE ROOF CONSTRUCTION can be seen in Plates V and VI. Plates 8 feet long, made of two 2x4's nailed together, were spiked on top of two opposite sections of the upper rim. Upon these were erected five pairs of rafters carrying a 2x6 ridge pole 19 feet long. To the lower ends of these rafters two 2x4's were spiked to take the place of the fascia of the cornice. Three shorter pairs of rafters were then attached to the ridge pole at each side of the first ones and held in place by stays, and other 2x4's, marked "fascia" in Plates V and VI, were spiked to the end of these. The roof sheathing was then put on and the short studding marked "A," "B," "C," "D," "E" and "F" in Plate VI were fitted in between the upper rim and the roof boards, or the rafters, as the case might be. The stays which had supported the rafters were removed. The gables were then sided up with $\frac{3}{8}$ -inch ceiling and the roof was shingled.

DOORS.—There are four feeding doors, each 2ft.x3ft. 10 in., made of matched flooring on a framework cut on the same radius as the silo, and with a hollow space of four inches on the inside. These doors are hung on heavy "T" hinges and are each provided with two $\frac{1}{2}$ -in.x2-in. hasps extending the full width of the door, and projecting beyond the front edge about two inches. When these doors are closed for filling, these hasps are fastened with a $\frac{3}{8}$ -inch carriage bolt through the silo wall and the projecting end of the hasp. In this way the doors can be so tightly closed as to make them nearly air tight.

PLATE VI.



A door, 3ft.x4ft., for filling, made of 1-inch flooring, was put in the gable.

VENTILATION OF SILOS.—Three $\frac{3}{4}$ -inch holes were bored through the outer walls of the silo between each pair of stud-
ding, and the inside sheathing was not continued quite to the upper rim, but a space of about two inches was left between the top of the sheathing and the bottom of the upper rim. This arrangement allows a free passage of air between the outer and inner walls of the silo during warm weather when decay is liable to occur. In cold weather these holes through the outer wall are covered by tacking a piece of thin siding over them.

The silo was finished by giving it two coats of paint.

Below is given a bill of material and labor. It is believed that the price of some of the material is too high, and that anyone having the cash to pay for it could make a considerable saving on this bill. The conditions under which this material was purchased were not so favorable to economy as they might have been. The prices given are, however, those paid; and all material, except the stone, which we had in abundance close at hand, and all the labor is included. It is also believed that the foundation of this silo is more expensive than would be necessary in most locations. The silo is located on the lower side of the barn between two stable doors. In the spring the drainage from the higher ground, and the tramping of the cattle often make the ground around the silo quite soft and muddy. On this account it was considered advisable to make the foundation quite substantial. For a silo of the same size located on a high, well drained site, a much cheaper foundation would do equally as well.

BILL OF MATERIAL.

100 2x4 16-foot long studding.....	1067 feet	
41 2x4 12-foot long rafters, sills, rim, etc. . .	483	
18 2x4 10-foot rafters and plate.....	120	
1 2x6 20-foot long ridge plate.....	20	
		1700 feet @ \$18 00 \$ 30 60
1900 feet No. 1 Lap siding, rabbeted @ \$27 50.....		52 20
4500 .. ½-inch Fencing, sheathing @ \$15.00.....		67 50
120 .. Flooring, for doors @ \$25.00.....		3 00
375 .. Boards, for roof @ \$18.00.....		6 75
200 .. ¾-inch Ceiling, for gable @ \$30.00.....		6 00
1 barrel Coal Tar		7 50
621 lbs. Tarred Felt @ \$2.00.....		12 40
3 M Shingles @ \$3.00.....		9 00
6 bbls. Cement @ \$5.00.....		30 00
400 lbs. Nails @ 3 cts.....		12 00
Hinges and hook		1 50
Heavy hasps and bolts for doors.....		6 20
		\$ 244 65
LABOR AND PAINT—		
Paint and painting.....	\$10 00	
Carpenter work @ \$3.00 per day.....	60 00	
Mason work @ \$3.50 per day.....	10 50	
Common laborers @ \$1.00 per day.....	8 00	88 15
		\$ 332 80
Total		\$ 332 80

FILLING THE SILO.—The corn was cut and bound with a McCormick corn harvester. The bundles were immediately piled upon low drays and hauled to the silo where a Belle City feed

cutter run by a steam engine cut them into $\frac{1}{2}$ inch lengths and elevated the silage to the filling door, thirty feet from the ground. We began cutting Aug. 24th when the corn was beginning to glaze, and finished September 4th. The silage was frequently leveled down and tramped next to the wall, but no further effort was made to pack it. No covering was put on.

The machinery and the work being entirely new to the men, some delays occurred which would not otherwise have been necessary. No exact figures can therefore be given as to the cost of filling: We believe, however, from our experience and from careful estimates, that the cost of growing corn or cane and putting it into the silo ought not to exceed *one dollar per ton*, with an average crop and proper facilities for handling.

GENERAL RESULTS.

The silo was opened and feeding began November 15th. It was found that the silage had moulded and was unfit for food to a depth of about 18 inches. Below this it had kept perfectly and was in fine condition, excepting a thin layer next to the wall. Our dairy herd has received more or less silage every day since the silo was first opened up to the present time (April 12th.) and will continue to do so until they are turned on the pastures. Forty pounds per head per day is the highest allowance given. None of the cattle refused to eat silage although a few showed a slight distaste for it at times, probably due to slight over feeding. During the coldest weather the silage froze to a depth of several inches, and it was found necessary to mix the frozen with the unfrozen portion in order, at least partially, to remove the frost before feeding. No bad effects were experienced from feeding this frosted silage, but the practice cannot be recommended where it is possible to avoid it.

On the whole, after one season's experience with this style of a silo, we feel warranted in pronouncing it a complete success. It is quite probable that in time we may be able to make some improvements upon it; but at present we know of no better, nor more economical style of a silo than this, when one feels that he can afford to invest in a really first-class building. Cheaper silos can be built and, as before stated, they may be the only kind that many of our farmers will feel justified in building at present. But as this country improves, as it certainly will in the next few years, and as the more scientific methods of dairying and stockraising are adopted, we firmly believe that a first-class silo will be considered as necessary as a first-class dairy barn, on every really up-to-date dairy farm in South Dakota.