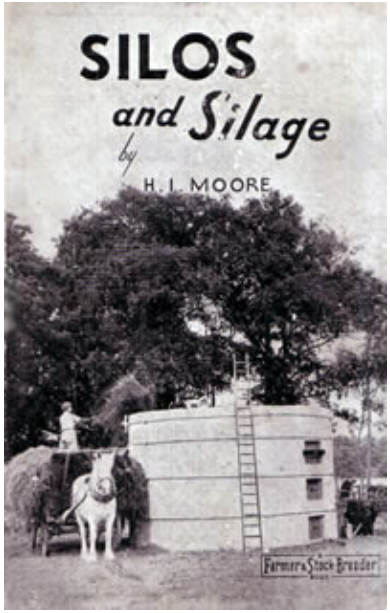

SILOS AND SILAGE

H. I. MOORE

A FARMER & STOCK-BREEDER BOOK,

Dorset House, Stamford Street , London , S.E.I

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FOREWORD

There is nothing mysterious about ensilage, as this thoroughly practical book shows. It is a process for the practical farmer just as much as harvest or haymaking

practical farmer just as much as harvest or haymaking, and it by-passes some of the difficulties in other practice that the most experienced cannot always overcome. The book is just what we might have expected from Mr. Moore, whose practical experience over more than ten years extends from the time when the tower silo was the alternative to pit or stack ensilage and throughout the period of the introduction of the smaller containers of wood, concrete and then of wire and paper, with consequent cheapening of the process.

Mr. Moore has worked for and seen improvements in the technique of silage making, and this with wide experience in general cropping led to his being seconded to the West Riding W.A.E.C. as cropping and silage officer. He has the ability to pass on his knowledge to farmers in non-technical language, as readers of The Farmer & Stock-Breeder have found.

He has supervised 30 large-scale practical demonstrations on the making and feeding of silage, besides many on

cropping and grassland.

During the past year, with the assistance of his staff, Mr. Moore has given assistance to 350 farmers in setting up the equipment for and starting the making of silage. In the past three years he has been called in to over 500 silos as a consultant and in ten has given over 150 lectures to farmers and paid an indefinite number of advisory visits.

This brief sketch (much more might be said) indicates Mr. Moore's extended and varied experience and explains the lucidity of this practical little volume.

PREFACE

If any justification is necessary for writing a book about silage, the pronouncements of those whose task it is to guide the ship of state on its present perilous voyage must be deemed an adequate reason.

The Prime Minister's warning, "Every endeavour must be

The Prime Minister's warning, "Every endeavour must be made to produce the greatest volume of food of which this fertile island is capable . . . ," and the Minister of Agriculture's more specific recommendation, " For the sake of your cattle, for the sake of your pocket, and for the sake of preserving all we can of our livestock," treat this silage question with all possible seriousness. Silage may

well prove the salvation of your stock," have riveted attention on ensilage. By this process the fruits of the soil, the lush grass, clover, and forage crops of summer, can be preserved conveniently and efficiently for use in the lean winter months.

In recent years great progress has been made in the technique of the process, and in the immediate future we may expect tremendous developments in the extent of the practice of ensilage.

Thus has arisen the need for a book, written in non-technical language, embodying the latest information on

the subject, and outlining those methods which personal knowledge and experience have shown to be sound and practical.

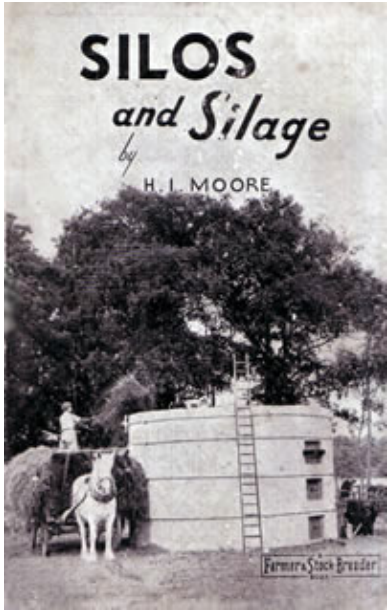
It is my sincere hope that this small volume will serve the

needs of the large number of farmers who are now seeking information on the subject.

I am indebted to my colleagues, Mr. T. L. Bywater, Mr. J. S. Willcox, and Mr. W. H. Long, for their help and suggestions in the preparation of the book.

H. I. moore,

June, 1941.



CHAPTER I

Silage and Farm Practice

The feeding of livestock in winter has been one of the major problems of farming in this country throughout our history. During the growing season grass is the natural food for most classes of livestock, but for a considerable part of the year it is not available as such in sufficient quantity to meet livestock requirements.

In bygone days the difficulty was overcome by drastically reducing the numbers each autumn by slaughtering and salting those that were fit for human consumption. The remainder were wintered on a very low plane of nutrition by means of such quantities of hay and straw as were available.

Naturally, under these conditions the fattening of livestock in winter was quite impossible, while the production of milk practically ceased each autumn when the grazing period finished.

It was not until crops like turnips and Swedes had come

into general cultivation in the 18th century, and improved strains of cereal, pulse and forage crops became available, that there was a sufficiency of suitable winter food to permit large numbers of livestock to be fattened or enable milk production to be maintained in the winter months. The position was further improved in respect of wintering livestock by the importation, which began at a later date, of concentrated foodstuffs into this country from abroad.

In these circumstances it became almost as easy to fatten stock or produce milk in winter as in summer; in fact, in the ten years before the outbreak of the present war, imported feeding stuffs were so cheap that it was held to be uneconomical as regards much of our land to grow arable crops at all. Thus a large acreage of plough land was sown away to grass, livestock numbers were increased, and for winter feeding farmers relied to an ever increasing extent on cheap imported feeding stuffs.

Those days are now over and the pendulum has swung in the other direction, for feeding stuffs are difficult to

the other direction, for feeding stuffs are difficult to import.

Self-Help

In future, therefore, we must rely upon the produce of our own farms to supply the needs of our livestock. Grass land properly grazed and maintained in a productive state will provide the solution to most of our stock feeding problems in the growing season; indeed, by adequate manuring and by re-seeding the grazing season can be very considerably extended.

There still remains that hungry gap between autumn frosts and spring sunshine, and this has got to be filled.

Silage making offers an efficient and economical means of bridging this gap, and is, therefore, of particular interest and value to British farming at the present time.

The process of ensilage consists of preserving green forage crops in a succulent condition for use out of

season. Silage is the name given to the product so obtained, and a silo is the container in which silage is made. There is little doubt that the process is of great antiquity and that the word silo is derived from a Latin word meaning a pit.

In its simplest form the process merely consists in storing forage crops in pits dug in the ground and afterwards covering them with soil. Various methods, however, have been adopted from time to time with the object of improving the quality of the product so obtained, and modern methods of ensilage have attained a high degree of efficiency.

History of Silage Making

The history of silage making in this country provides an excellent object lesson in pointing out the pitfalls that beset the unwary silage maker, and a brief review, therefore, will not be out of place here.

The problem of making hay in bad weather has always been a trouble to farmers in this country, but never more so than in the exceptionally wet seasons following 1879. They were, therefore, ready to consider new ideas, and when in 1882, a Frenchman, the Vicomte de Chezelles, paid a visit to the Royal Show at Reading and there gave an account of his methods of making silage, great stimulus was given to the practice.

Silos of many descriptions were constructed throughout the country, the common type being the pit dug in the ground. That this type was so prevalent was probably unfortunate, for unless great care is taken in making pit silage the waste is unduly high and the product apt to be sour.

There is no doubt that much bad silage was made at that time, and this fact did not help to establish the practice, while the report of a Royal Commission, appointed in

1885-1886 to consider the possibilities of ensilage in this country, did little to advance matters. Thus in the following years the practice virtually disappeared from British farming, though a few faithful and successful adherents remained.

During the period that these efforts were being made in this country ensilage was introduced into North America,

where it at once caught hold and has continued to flourish ever since, until at the present time the majority of farms in Canada and the United States carry a silo.

American Popularity

Several factors contributed to this state of affairs, the chief one undoubtedly being the adoption of the tower silo as the standard type. This silo gives a uniform product with very little waste, upkeep costs are low, and it is simple and easy to fill. Thus, American farmers started on a sound foundation. Moreover, maize has always been their chief silage crop, and this gives a good quality

their chief silage crop, and this gives a good quality product and a large and reliable yield per acre.

Hence root crops, much favoured by British farmers, and out yielding silage crops on good land, were favoured rather than oats and tares, which appeared to be the best

suited for ensilage in this country.

In spite of the undoubted "waste" attaching to the process as then practised, some farmers still found it worth while to make silage in one way or another. In 1901 a tower silo was erected at the College Farm, Wye, and experiments were carried out with maize as the chief crop. The results, however, showed rather a high loss in feeding value and did not help, therefore, to spread the practice.

In 1910, Mr. George Jacques erected a tower silo on his farm at Tivetshall, Norfolk , and filled it with oats and tares. This was successful, and his advocacy of the practice helped to establish it in the eastern counties. From then on it spread throughout the country, though

From then on it spread throughout the country, though never reaching spectacular proportions.

On many heavy-land farms where roots are a precarious

crop silage as a substitute has been made ever since. Many dairy farmers also have continued to use it over a period of years, as well as others whose land was too light for roots and too shallow for good hay crops. The cost of tower silos has generally been prohibitive, and the great majority of farmers have been apathetic.

During the last ten years, however, radical changes in the process have again brought it to the public notice. This is due in large measure to the excellent research work of Dr. H. E. Woodman, of the Animal Nutrition Research Station, Cambridge , and Dr. S. J. Watson, of Imperial Chemical Industries' Research Station, Jealott's Hill.

Possible on any Farm

As a result of this work it has been established that high-

quality silage, which forms a perfect substitute for

imported concentrates, can be made on any farm simply and cheaply without expensive equipment. Moreover, the introduction of small portable silos in place of the large permanent towers has brought the practice within the reach of the smallest farm, and there are now good grounds for believing that the practice of ensilage will become firmly established as part of British farming, and that the day is not far distant when the majority of farms will have their silos.

Ensilage fits well into our normal farm practice. It requires no special equipment other than the provision of a suitable container or silo, and even this can be dispensed with if need be. In addition, it has the decided advantage, under our climatic conditions, that it is a process independent of the weather.

Choice of Three Methods

In considering the possibilities of making silage a farmer

In considering the possibilities of making silage a farmer has a choice of three methods. He can produce high-quality silage from young leafy grass, seeds mixture, lucerne, or sainfoin, securing a perfect substitute for concentrated foods, balanced for meat or milk production.

To produce this silage means cutting the crop at the correct stage of growth, and hence it is necessary to plan ahead with the same forethought that is given to any other crop. In other words, it must become part of routine practice, and the fields will be fertilised and managed in order to provide several cuts of short, highly nutritious herbage in the season.

On the other hand, a farmer might make a silage of lower feeding value, which will be a substitute for hay or roots or both. Such material will, in general, be made from oat and tare mixtures, or oat, pea and bean mixtures or from

maize where this crop can be grown. The ensiling of these crops will take place in mid-summer between the normal hay and corn harvests, though maize will be a few weeks

hay and corn harvests, though maize will be a few weeks later.

Wherever roots are a precarious crop—as on heavy land where good seed beds are difficult to obtain or the plant is patchy owing to uneven germination, or perhaps in districts where turnip " fly" is a great menace or seasonal labour for hoeing is difficult to obtain—a silage mixture offers several advantages, chief of which is the fact that it can be relied upon to give good yields under widely varying conditions of soil and climate.

The third consideration is the utilisation of all surplus green food on the farm. On most farms crops surplus to immediate requirements are available at some period during the year, and rather than allow these to go to

waste they can be made into silage for winter feeding. In a wet season, for instance, a flush of grass is apt to be trampled down by the stock and wasted, potatoes may be a bumper crop and a large surplus left on hand at the end of the season, or beet tops may be in greater quantity than

can be fed fresh on the land. These and many other crops can be made into useful silage.

This silage might be termed "by-product silage" and will form a useful maintenance diet, replacing roots or hay in the rations. Moreover, rather than lose the hay crop completely in wet years, the grass can be converted into silage, the product so obtained falling into this group of maintenance foods.

Essential for Self-Sufficiency

These advantages in themselves are sufficient in normal

times to merit the serious consideration of farmers. In war time, however, when each farmer must ask himself "in what way can I become more self-supporting in animal foods?" the claims of silage are outstanding. It is not simply *desirable* to make silage—*it is essential.*

Not only is well-made silage a most useful food for all

classes of farm animals, but a good stock of it makes a farmer independent of purchased feeding stuffs. The needs of the human population demand large increases in our arable acreage, and this in turn demands the utmost production from our diminished area of grass land.

Our grass land can produce much more than it actually does. This must be apparent to all who are conversant with farming in Britain . Suitable manuring and mechanical treatment will increase the output from much of our grass land three-fold, four-fold, or even more. Ensilage will

ensure that the surplus is not wasted and that the resources of the soil shall be harnessed by the best available means.

A further advantage attached to ensilage is the fact that the product will store indefinitely without appreciable deterioration, and thus the products of an abundant season can be used to alleviate the hardships of the lean season that is apt to follow.

Also silage is not subject to the danger of firing from overheating, or to spoiling by vermin. It is not damaged by frost and can be given to stock at any time of the year.

Why Silage was Unpopular

Farmers frequently suggest that as ensilage has not hitherto developed in this country since its introduction

something must be wrong with it. It is true that in the early days of silage making faulty methods resulted in much wasted material, and errors damped enthusiasm for a process that had attracted so much attention.

Rapid progress has been made since then in the technique and equipment, and experience has shown that such equipment as is necessary quickly pays for itself. Moreover, there is a vast difference in the quality of modern silage and that prepared under the old methods.

Until recently silage could only be regarded as a substitute

Until recently silage could only be regarded as a substitute for hay or roots and there was no known method for improving this quality. It is now possible, however, to produce a protein-rich silage that forms a perfect food for stock in winter.

Complementary to Haymaking

The possibility of making grass into silage instead of hay during adverse weather conditions has led to the common misunderstanding that silage is merely a substitute for hay and that the process is only applicable in wet seasons.

Actually, of course, ensilage is complementary to haymaking, and is never likely to be a rival process. Nor for that matter is silage a rival of dried grass, but again complementary to it, and a clear understanding of the differences between the three processes and their products is necessary if each is to be seen in its true perspective.

Feeding value in the case of any preserved herbage

depends in the first place on the quality of the fresh crop. Grasses and clovers are at their maximum feeding value when four to six inches in height and as flowering approaches so the feeding value falls. To cut at the early,

short stage and dry by natural means is extremely difficult, and in our climate a very risky procedure.

Artificial drying, on the other hand, is a highly efficient method of dealing with this type of material, and the feeding value of the product is only slightly less than that of the dry matter of the fresh material. Unfortunately the process is costly, and the output from the drying plant is limited by factors outside the control of the farmer.

In general practice the grasses are allowed to reach the flowering stage, when the crop can be conveniently handled and made into hay. The product is a bulky fodder of relatively low feeding value.

Preservation of herbage by ensiling is fundamentally

different from haymaking, for reliance is not placed upon drying but upon fermentation by bacteria. It enables

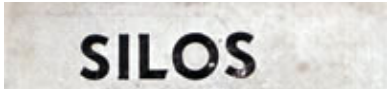
young herbage rich in protein to be preserved in a succulent state when at its maximum feeding value. Fortunately, this preservation results in but little loss in feeding value, and whereas ensilage is not quite so efficient a process as drying it is much more so than hay-making.

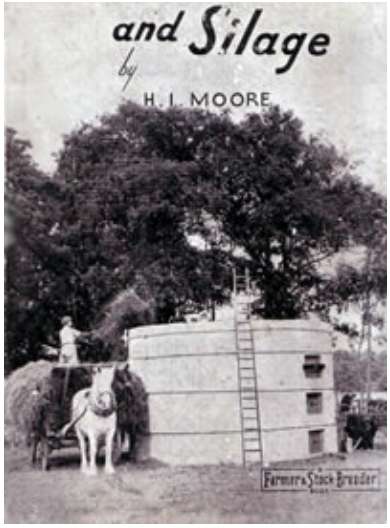
In haymaking, not only is the crop generally cut at an advanced state of maturity when it is low in feeding value, but it is subject to additional serious losses during bad weather. Exposure to rain after cutting leaches away much of the soluble nutrient matter; in hot weather the leaves become brittle and are lost in the field, while the crop is badly bleached by the sun, and since the green colouring matter of plants is intimately connected with the vitamin content this latter loss is very serious.

Ensiled crops are riches banked against the many

misfortunes that can beset the farming enterprise.

Further, they are little subject to destruction by fire in the manner of hay ricks or dried grass. In the following chapters practical guidance is given on the many and varied aspects of ensilage, from the production of a high-protein feed from crops grown especially for the purpose to the comparatively simple means of utilising any surplus that there may be on the farm.



CHAPTER II

Illustrations

Principles of Silage Making

Before good silage can be produced with regularity from different crops under widely-differing conditions of dryness or maturity, high protein content or high starch content, it is essential to have a proper understanding of

the changes that take place in the crop before it emerges from the silo as silage.

The process is one of fermentation, and the whole art of making good silage depends upon controlling the fermentation within fairly narrow limits.

Plants obtain their food from the soil and from the air. Water from the soil and carbon dioxide from the air enable the plant to manufacture sugar, starch and other complex carbohydrates.

Nitrates in the soil are absorbed by the plant and give rise to substances called amides and amino-acids, and from

these the complex nitrogenous products known as proteins are formed. Thus the plant can absorb simple materials from which it builds up complex organic compounds, the chief of which, as we have seen, are carbohydrates and proteins.

Ensilage is really the reverse of this building up process whereby the carbohydrates are broken down to form the gas carbon dioxide and organic acids, and the proteins will be reduced to amino-acids. This breaking-down process is known as fermentation, and is carried out partly by the plant but more especially by the action of bacteria.

This is how the process works. When a green crop is packed into a silo the cells of the plant are still alive, and hence breathing or respiration takes place. Entangled in the mass of material is air and some of this inevitably remains even after the material has been packed tightly into the silo by treading. So long as any air is present respiration will continue and carbon dioxide is evolved.

In a tower silo this carbon dioxide may collect and constitute a source of danger to life. Fatal accidents have occurred when workers have entered tower silos without first taking the precaution to circulate the air inside the silo and expel this undesirable gas. Respiration always accompanies a rise in temperature when the material may

accompanies a rise in temperature when the material may be noticed to be "heating." As a result of the increase in temperature and the exhaustion of the air entrapped in the mass the plant cells die and bacterial changes then set in.

Bacteria Multiply

On its leaves and stems the crop carries large numbers of bacteria, which now begin to multiply rapidly, using the sap of the dead plant cells for food. From the sap they

produce lactic, acetic, and butyric acids. Lactic acid is the acid present in sour milk, acetic is the acid of vinegar, and butyric acid, that which gives rancid butter its pungent and obnoxious odour.

Of these acids lactic will be the dominant one in good silage and usually constitutes from 0.5 to 2 per cent, of the fresh weight of silage.

As might be expected, all the bacteria present on the crop are not of a desirable type, and under certain conditions

the organisms that produce butyric acid may gain the upper hand. This will result in the production of an evil-smelling type of silage, which is generally refused by stock, although not invariably so.

Lactic acid type of fermentation is characterised by a pleasant acid, fruity odour; while the predominance of

acetic acid will give the silage a sharp vinegary smell.

Lactic Acid Fermentation

It is the lactic acid organisms that must be encouraged, and fortunately for silage makers these organisms will exert a dominating influence over all other types of fermentation provided the right conditions for their multiplication are present. Thus every endeavour must be made to promote a lactic fermentation, thereby obtaining in the mass a degree of acidity at which the undesirable bacteria are unable to work. Upon this success depends.

The heating that takes place in the silo owing to respiration is of considerable importance in so far as it influences the type of fermentation that will subsequently take place.

The more air present the greater is the respiration that follows, and hence the higher is the resulting temperature. To control respiration, therefore, will control the temperature, which means that we must restrict the amount of air present.

In practice the only control we have over the amount of air that is present is the degree of treading or compaction given to the crop, for the greater the compaction the more air will be expelled, and respiration will, therefore, cease at an early stage.

The efficiency of treading, of course, is largely dependent upon the moisture content of the material. If the crop is mature and has a low moisture content, or if it is stemmy

and coarse in structure, or has been allowed partially to dry out in the field, compression will be difficult to obtain, and high temperatures will result.

Under these conditions the control of the temperature can be best effected by chaffing the crop, thereby reducing the air space and promoting more efficient packing in the silo, and by the addition of heavy weights to the top of the material.

On the other hand, a very wet crop or one cut at a very immature stage will pack tightly, and a degree of compaction may be reached at which the amount of air present is so small that respiration is drastically curtailed and little or no heating takes place. Too rapid filling of a large quantity of material will have the same effect in preventing heating in the lower layers. Too low a temperature can be a worse fault than too high a temperature.

Temperature Controls

Temperature, therefore, is controlled by three factors—(1) the dryness of the crop, (2) the amount of treading in the silo, and (3) the rate of filling, and these factors must be watched carefully.

Whilst temperature has considerable effect upon the subsequent changes that take place in a silo, it does not exercise complete control over the course of bacterial action. For example, at high temperatures (over 120 degrees Fahrenheit) no undesirable fermentation is likely to take place, and in the early days of silage making such temperatures were actually advocated. Heating to such a pitch results in the production of a sweet, dark brown type of silage, which, though palatable to stock, has lost a good deal of its digestibility and is consequently of lower nutritive value.

These high temperatures are frequently obtained in stack silos, for, however careful one may be, really efficient

treading is impossible in the stack method. The lactic organisms grow best at temperatures between 80 and 100 degrees Fahrenheit, whilst lower temperatures favour the undesirable bacteria, and when the temperature falls below 80 degrees Fahrenheit the chances of producing an evil smelling, butyric type of silage are increased.

Differing Layers

To encourage a lactic type of fermentation we must see that the mass attains a temperature of 80 to 100 degrees Fahrenheit, and round about 90 degrees Fahrenheit is the point at which to aim. In order to ensure a uniform product throughout the silo each day's filling must attain this temperature. Many silos fail on this score, and one frequently finds different types of silage at different levels in the silo.

Towards the bottom, if heating has been insufficient, there will be a strong-smelling butyric acid silage of a yellowish green colour, whilst towards the top, the colour may

darken almost to black and the material has the sweet pleasant smell of good tobacco. Too rapid filling of the silo will produce stratification of this type.

Thus, in order to obtain a uniform product throughout the silo it is necessary to ensure that the bottom layers in the silo are allowed sufficient time to heat to 90 degrees Fahrenheit before filling proceeds, and that the topmost layers receive extra attention by efficient treading and the addition of weights to keep the temperature down.

The factor of acidity is equally important with that of temperature. The acidity of any material is measured by a scale referred to by chemists as the pH scale. On this scale the number 7 represents the neutral point where the

substance is neither acid nor alkaline in reaction. Numbers above 7 indicate increasing alkalinity, whilst numbers below 7 denote increasing acidity. For instance, a silage having a pH of 5 is much more acid than one with a *pH* of 6, and if the pH is, say, 8, it is alkaline in reaction.

In order to obtain good silage it is essential to have an acidity of the material greater than pH 4.5, say, *pH* 4 or even less. This will prevent the putrefying bacteria from working and will keep the crop in good edible condition.

It should be added that whereas temperature is within our control the only means of controlling the pH level is by creating favourable conditions for the rapid production of lactic acid. As we have seen already, this can be done by carefully watching the temperature and ensuring an adequate supply of carbohydrates from which the bacteria manufacture the acid. If the crop is mature carbohydrate

will be present in adequate amounts, but when sufficient carbohydrate is not present, as with protein-rich foods like young grass or clover, the need for the addition of molasses arises.

Getting a Sample Tested

Unfortunately, one cannot take a check of the pH during

ensiling, but when the silage is being used it is a good plan to send a sample to the nearest University or Agricultural College for a pH determination. This information will form a useful guide to subsequent working.

The danger of encouraging a butyric fermentation is that when this kind of fermentation occurs the proteins are often decomposed in such a way as to produce toxic substances harmful to stock. Should silage with a high

butyric acid content be produced it should be used with care and given in moderate quantities. Particularly is this necessary with milk cows that are fed indoors.

It will be seen that successful ensilage depends upon simple but well-adjusted conditions, and that haphazard methods can only result in waste and disappointment for the maker.

Keeping Records

Given patience and care there is no reason why the best silage should not be produced on any farm, but experience is necessary before good silage from different crops can be produced with equal facility. For this reason the keeping of a simple but detailed record book is urged. When this is completed it will be possible to correlate the conditions at ensiling with the type of product obtained,

and by the end of the first season one may determine where faults have arisen and steps can be taken to avoid these pitfalls thereafter.

The following specimen page from the author's own record book will serve as a guide to the type of data that should be recorded:-

SILAGE RECORD SHEET

Type of Silo: **Pig fencing and Sisal paper.**

Capacity: **30 tons**

***Capacity:* 30 tons.**

***Crop:* Clover aftermath.**

***Conditions at Cutting:* 8 in. long. Clover in knot.**

***Conditions at Carting:* Dull weather—crop damp.**

***Strength molasses used: 1.5* gal. Molasses, 1.5 gal. Water per ton crop.**

Amounts filled per day:

1st day, 5 ft. 5th day, Nil. (sunk to 8 ft.)

2nd day, Nil (sunk to 3 ft.) 6th day, 3 ft.

3rd day, 5 ft. 7th day, Soiled down.

4th day, 5 ft. 8th day, —

***Topping Up:* Completed 7th day—covered bags, then 6 in. soil rammed home**

Date Opening Silo: **January 15th, 1940 .**

Type of Silage Produced: **Yellow-Brown—acid smell.**

Waste: 2 in. **on top—nil at sides.**

Analysis: **(University Report and Comments), *pH* 4.47.**

Dry Matter, 30 per cent.

Crude Protein, 17.98 per cent.

This should prove an adequate substitute for cake:

16 Ib. should replace 3.5 Ib.balanced dairy ration.

Stock Receiving Silage:

Stock Receiving Silage:

Milk Cows, 32 lb. per day for 2 gallons.

Calves, forkful.

Ewes, 5 lb. per day

Comments:

Up to the standard of the analysis: Marked effect on the colour of the milk.

Faults

So far we have seen that the breakdown of the carbohydrate produces lactic acid, which acts as a preservative: but it is a legitimate question to ask what happens to the protein. In making silage, the object must

be to reduce protein breakdown to a minimum, and this can only be assured by making conditions favourable for the rapid acidification of the mass.

Under conditions favouring a butyric type of fermentation, say for instance, where the material does not heat up or where the crop is poor in carbohydrate, protein breakdown may be considerable. Not only will protein breakdown lower the feeding value of the silage, as is to be expected, but it may also give rise to putrefactive changes resulting in the production of toxic substances.

In good silage the loss of digestible crude protein may be as low as 10 per cent., but in bad silage it may be as high as 40 per cent. It is well to remember, therefore, that, careful as one may be, some loss in feeding value is inevitable; the main thing to bear in mind is to try and make this loss a minimum by carefully attending to

essential details in the making of the silage.

The occurrence of moulds in carelessly made silage can be

The occurrence of moulds in carelessly made silage can be a source of much waste, and their presence is evidence that air has not been adequately excluded. Moulds will no doubt grow for a short while when the crop is packed into the silo, but this will cease with the disappearance of the air, which normally occurs in a few hours time.

Mouldy samples of silage are inedible and may even be harmful to stock. Mould can always be taken as a sign of bad silage and its presence a reflection on the work of the silage makers. Patches of mould here and there throughout the mass of material indicate the presence of air pockets, which are invariably due to failure to shake out each forkful of greenstuff as it is packed into the silo.

Colour

Another and obvious change that occurs in the silo is in the colour of the crop. At high temperatures charring will take place and the material will become black. The normal colour of good silage can best be described as a light greenish brown to yellowish brown.

greenish brown to yellowish brown.

When a very immature crop is ensiled the colour may be olive green, denoting only a low temperature. This colour range from olive green through combinations of browns to black is an indication of the temperature attained in the silo, a dark brown colour denoting that the temperature has risen above 120 degrees Fahrenheit, and an olive green that it has been below 80 degrees Fahrenheit.

The most important colouring matter in green crops is carotene, a yellow colouring matter that can be changed by the animal into Vitamin A, which is a growth-promoting and disease-resisting factor. The effect of carotene in the

ration is perhaps most strikingly demonstrated with dairy cows.

One invariably notes the marked effect on the colour of the milk when cows are first turned out to grass in the spring, whereas in winter, when the cows are on artificial foods, the colour is apt to fade and the milk to appear

weak and "blue" Now the depth of the yellow tint produced in milk is roughly proportional to the amount of carotene fed, and hence by using a carotene-rich food like silage it is possible to maintain the summer colour of milk throughout the winter feeding period.

The response of cows to the introduction of silage into the ration is soon demonstrated by this improvement in the colour of the milk.

Two methods of making silage are in use in this country at

the present time, and they can be described very simply as: (1) The Ordinary Method, (2) The Molasses Method.

(1) The Ordinary Method

Crops cut at a mature stage of growth, such as an oat and tare crop cut when the oat kernels are soft and cheesy and the tares are forming seeds, contain a relatively high proportion of

carbohydrate to protein. The carbohydrate present will supply all the sugary material necessary for the development of lactic acid, and hence the necessity for any additional molasses or sugar does not arise. This applies not only to oat and tare crops but also to grass cut at the hay stage, to pea haulms when well podded, and to starchy crops like the potato or sugary crops like beet tops.

Two types of ordinary silage can be produced, depending upon the temperature attained during ensiling. If this lies between 80 degrees and 100 degrees Fahrenheit a low temperature silage results, whereas if the temperature rises to 120 degrees Fahrenheit or more the product is known as high temperature silage.

To keep the temperature below 100 degrees Fahrenheit a container of some type is necessary in order to exclude air, and the material must be

tightly packed into it to squeeze out as much air as possible. To facilitate this, chopping is necessary if the crops are long and coarse.

Thermometer Recommended

The use of a thermometer in silage making is

strongly advocated, for without it one is working to a great extent in the dark.

For this purpose a maximum thermometer will be found most serviceable: it should be attached to a length of string and be inserted about two feet below the surface of the silage at the end of each day's filling. In this way it is an easy matter to decide whether the silage has heated sufficiently or not. If it has, then filling can proceed, but if not, time can be allowed for the necessary heat to develop.

Checking the temperature in this way is more

Checking the temperature in this way is more necessary with young grass and crops having a high water content, for they do not always heat readily. With maize, cereal-legume mixtures, and mature grass, especially when chaffed, filling can generally be rapid and continuous.

With such material it is only necessary to take precautions when a tall cylindrical silo is being used, and here care is necessary to ensure that the lower layers of silage attain the desired temperature. If this is not done a sour type of silage is likely to be obtained in the bottom four or five feet.

Leguminous crops, such as lucerne or clover mixtures, are low in fermentable carbohydrates, especially if cut before flowering. As a result, unless care is taken a strong type of silage will result. To minimise this, the crops should not be cut before flowering, nor should they be ensiled in

cut before flowering, nor should they be ensiled in a wet condition unless the deficiency of carbohydrate is made good by the addition of molasses.

Low Temperature Product

The product obtained by the ordinary process when the temperature lies between 80 and 100 degrees Fahrenheit is known as acid light brown silage. It is yellowish brown in colour, and has a sharply acid, though pleasant smell.

When a container is not available the crop will have to be ensiled in a stack or pit. With these methods it is extremely difficult to control the temperature, especially in the stack, in which the temperature invariably rises above 120 degrees Fahrenheit and the product is known as sweet dark brown silage.

As its name implies, this is dark brown in colour,

varying in intensity according to the degree of heating that takes place, and has a pleasant smell of over-heated hay. Stock are ravenously fond of it and hence sweet silage is overrated.

Farmers naturally like to see their stock relishing a food, but owing to the high temperature attained the loss in feeding value is very considerable. For this reason the use of a silo is advocated, although the fact that no capital outlay is necessary in building a stack is certainly attractive. When a crop of hay has been partially spoiled by rain, of course, the position is different, and here the stack method is undoubtedly indicated, for it is better to make indifferent silage rather than lose the crop.

On the other hand, much better consolidation can be obtained in a pit silo, for horse and cart can be

taken over the top, and this is a great help. Thus one generally obtains acid light brown silage in at

one generally obtains acid light brown silage in at least the lower layers of the pit. Failure to consolidate the top layers may produce here a certain amount of sweet silage. Similarly in the top layers of a tower silo several feet of dark brown silage will be obtained.

(2) The Molasses Method

As mentioned already, young crops cut before flowering has taken place are rich in protein but low in carbohydrate. When ensiled by ordinary methods they frequently give very disappointing results, yet in order to obtain a protein-rich food it is essential to cut the crops when young.

The dominating factor for successful silage making

is the rapid production of lactic acid, and thus in order to enable the desired degree of acidity to be formed in crops poor in fermentable carbohydrate it is usual to add molasses during ensiling. Young

It is usual to add molasses during ensiling. Young leafy grass, for example, has a high protein content, but is comparatively poor in carbohydrates.

By the addition of molasses this deficiency is made good and the formation of adequate amounts of lactic acid is ensured. By this means one may attain the necessary degree of acidity at which the undesirable bacteria are unable to work.

Obviously, when dealing with a protein-rich food, losses must be kept at a minimum and this implies the use of low temperatures.

As already indicated, temperatures of the order of 90 degrees Fahrenheit can only be attained when a container is used, so that air can be excluded from the mass. Molasses can of course be used with advantage in the making of stack silage from young crops, but when valuable material of this type is

being converted it seems wasteful to stack it when a container will eliminate most of the waste. Not only is it impossible in a stack silo to control the temperature within the desirable limits, but the adoption of this method is bound to lead to wasted material round the outside of the stack.

Object of Adding Molasses

It will now be readily appreciated that the addition of molasses is purely to encourage the production of lactic acid. There seems to be some confusion

about this amongst farmers, many of whom have the impression that the molasses is merely a sweetening agent that renders the crop more palatable.

This impression has doubtless arisen from the practice of mixing molasses with chaff or poor hay to encourage the consumption of these low grade

foods. Any excess molasses will naturally have a high feeding value, and the fact that excess is not harmful is a factor contributing to the tremendous success of the method.

Crops rich in carbohydrates do not require the addition of molasses, though it is no disadvantage to use it, and in fact, in certain cases the addition of a dilute solution of molasses to a crop which is anticipated to have an adequate content of carbo-

hydrate may be advantageous. The solution will

assist the packing of a dry crop, but the same effect can, of course, be got at much less cost merely by using water alone.

Other starchy materials, such as sugar beet pulp, potato flakes, and molassed meal preparations have been used to replace molasses. In use, however, they suffer the disadvantage that it is extremely difficult to distribute them evenly

extremely difficult to distribute them evenly throughout the mass of material, a fact that does not apply to the use of a solution.

The use of lactic organisms has also received considerable attention, this being considered by many to be a more direct approach to the problem of rapid acidification of the mass.

Conclusive evidence is not yet available on this point and, meantime, farmers can rest assured that by the use of a molasses solution the desired result can be obtained with the minimum of trouble. The crop usually carries large numbers of lactic acid organisms of its own, and these merely need the right conditions for them to commence work at fever pitch.

A.I.V. Silage

Mention must now be made of the A.I.V. method of making silage, by which process the degree of

making silage, by which process the degree of acidity necessary to prevent undesirable bacterial activity is obtained by the addition of A.I.V. acid direct.

This process takes its name from Professor A. I.

Virtanen, of Finland , who showed that in order to reduce losses in silage making it was necessary to bring the material to a level of acidity between *pH* 3.5 and pH 4.0 as rapidly as possible.

The method might be called the direct acidification method in contrast to the molasses method, which involves indirect acidification. In its practical application, however, it has decided drawbacks, for the concentrated acid is dangerous to handle. Further, the requisite quantity of acid must be carefully adjusted to the moisture content, the protein content, and the original acidity of the crop, which necessitates the services of a chemist on the farm.

farm.

In addition, surplus acid in the silage can cause serious scouring amongst the stock. With dairy

cows the direct result of this scouring will be a fall in the milk yield.

A.I.V. Superseded

In view of the fact that the molasses method is so simple and straightforward, and gives such uniformly good results, it is unlikely that the A.I.V. method will attain any measure of popularity in this country.

From my experience of both methods I strongly advise the use of the molasses method.

The introduction of the A.I.V. and molasses methods has revolutionised the making of silage in this country. Where silage was formerly not rated highly, because it was considered to be merely a

highly, because it was considered to be merely a

substitute for hay or roots, by the adoption of modern methods it is now possible to ensile crops rich in protein without the fear of producing evil smelling, undesirable types of silage which in days gone by caused so much dissatisfaction. No longer can silage be regarded merely as roughage, but rather as a watered concentrate.

In concluding this chapter it is necessary to issue a definite warning.

The use of modern methods cannot create feeding value where this is not present in the original crop. The process is not creative, but merely preservative.

Poor Material: Poor Silage

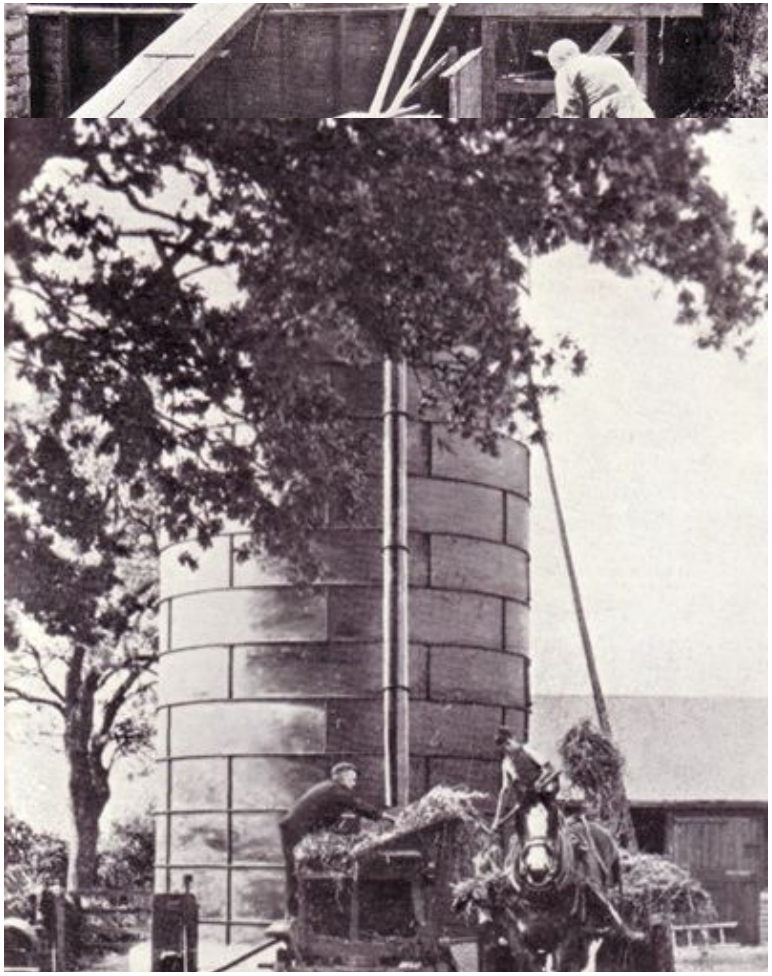
To produce protein-rich silage, crops rich in protein must

To produce protein-rich silage, crops rich in protein must be used and the crop must be cut young. Nor does the use of molasses permit any laxity in the filling of the silo, for uniform packing is essential. The biggest mistake in silage making is to assume that any sort of crop can be ensiled with equal success. Poor material can only make poor silage, but nevertheless, there is much waste material that will often make better silage than hay. The crop intended, however, for high quality silage must be specially selected for the purpose.

Better to mow a laid corn crop for silage than allow it to

waste

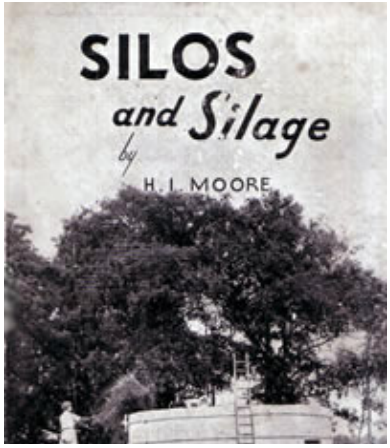
The hay chopper erected to allow the silage crop to be chopped



The tower silo being filled by means of a chopper and blower

SILOS AND SILAGE

FOREWORD and PREFACE



CHAPTER III

Crops for Ensilage

Most herbaceous crops can be made into good silage, although some entail more attention to small details in the process than others. At one time, for instance, members of the cabbage family were considered quite unsuitable for ensilage, but recent developments in technique have made it possible to produce excellent quality silage from such crops as kale, rape and turnip tops.

We can consider silage crops as falling in the main within three groups, namely: grassland, arable, and by-product groups.

Grassland Silage Crops

Grassland gives by far the most important of our silage crops, for not only is the product in abundant and cheap supply but it forms a perfect food for all classes of stock. Good grass silage can rightly be regarded as a "watered

concentrate" or as "canned grass "for the production of meat or milk. Herbage from meadows and pastures consists chiefly of various grasses and clovers, with miscellaneous plants such as dandelions, ribgrass, daisies and many others. Contrary to what might be anticipated the feeding value of this herbage does not depend so much upon the relative amounts of the different constituents present, or for that matter the season of the year, but upon the age of the material when cut. The younger the plant the higher the feeding value.

Another factor of considerable importance is that the leaf of the plant has a higher feeding value than the stem, being richer in protein, with less fibre, and possessing a

higher digestibility. In consequence of this, if we are to strive for high quality grass silage, it is necessary to cut the grass when it is immature and leafy. In practice the grass is cut when about six to eight inches long, for it is difficult to collect grass with normal farm implements if cut at an earlier stage of growth, although some farmers have special implements.

Early Cutting Essential

In spring when growth is rapid plants strive to produce seed and thereby ensure the continuance of their species, and this means that they pass quickly from the leafy to the stemmy stage. They are not likely to remain, therefore, at the stage of maximum feeding value, and no time must be wasted in cutting the crop if high quality silage is to be made.

This is not true of grass in autumn, by which time the function of the plant is to produce in the leaves food that

can be stored in the roots for use during the resting period. Thus in autumn, cutting can take place over a longer period.

When grasses are allowed to reach the hay stage the protein content is a good deal lower than it is when the plant is young and leafy, and hence silage made from a crop cut at this stage cannot be regarded in the light of a concentrated food, but rather in the nature of a hay substitute or maintenance food. On the other hand, if the silage is made from short, leafy grass the crude protein content may be of the order of 16 to 20 per cent., and about 20 lb. of this type of silage will contain sufficient protein and carbohydrate to produce a gallon of milk and will replace 3.25 lb. of balanced dairy ration.

It is quite clear, therefore, that the production of high-quality silage from young grass will necessitate a sound grassland policy, the main object of which is the production of a large supply of leafy grass over a long

period. The grass land must be in good condition and contain the right species of grasses in order that several cuts may be obtained in a season. Not only will generous applications of nitrogenous fertilisers be necessary, but the lime, phosphate and potash content of the soil will have to be maintained at a high level.

Safeguarding Best Species

Manuring alone, however, is not sufficient, and wise stocking must go hand in hand with generous manuring if the best is to be got out of the grass land. To safeguard the high-yielding species it is necessary, therefore, not only to practise what is commonly called rotational manuring, but also rotational grazing.

Obviously, no one system is applicable to the wide variations of soil, climate and farm practice which are to

be found in this country, but the following suggestions may be taken as a basis.

Starting with the best pasture on the farm it should be given a dressing of nitrogenous fertiliser, say 1-2 cwt. per acre sulphate of ammonia or nitro-chalk in February. This will produce an early bite and grazing should continue until August. The field should then be top dressed again and shut up for mowing for high quality silage in late September or early October.

During the winter the field should be well spike-harrowed and should then—the earlier the better —get an application of basic slag or superphosphate at the rate of 5 to 10 cwt. per acre. On light land, potash salts at the rate of 2 cwt. per acre should be given in addition to the phosphates. In the first season the heavy grazing will have encouraged the clovers but this must not be overdone, and hence in the second year the grasses should receive attention.

An early cut for silage should be taken, after which the field can be top dressed with sulphate of ammonia or

nitro-chalk for a second clip. Any further growth of grass will be grazed down in autumn.

During the second winter farmyard manure at the rate of 10-12 tons per acre should be spread, with the object of promoting a heavy crop of hay in the third year. The aftermath will be grazed and the pasture rested in late autumn and winter in readiness for the production of an early spring bite, which will commence the rotation on its second round.

Grass land treated in this way will yield on an average 4 tons of fresh 'grass per acre per cut, which means 3 tons of high quality silage per acre.

Clover, lucerne, and sainfoin leys are comparable with young grass in producing high quality silage.

All these young protein-rich herbage plants are deficient in carbohydrate, and hence for the rapid production of lactic acid during ensiling the addition of molasses is necessary.

necessary.

Arable Silage Crops

Cereal-Legume Mixtures

On arable land, silage mixtures generally take the place of roots. The first essential of such a crop, therefore, is that it should be a reliable yielder, in order that a succulent food for winter feeding should be ensured. In addition, since it is replacing the cleaning crop of the rotation it must provide

the opportunity for weed control before sowing or after harvesting, or exert a good smothering effect on any weeds likely to be present. Further, if the crop can be cut between the normal hay and corn harvests it will be convenient for labour.

In this country oats and tares constitute the most common silage mixture for arable land. Tares are easily grown, are reliable in yield, not too

easily grown, are reliable in yield, not too fastidious as to soil conditions, and their feeding value is high. Peas do better than tares on some farms and will then replace them. Unfortunately, the stems of both plants are too weak to hold them erect and a supporting crop is necessary. Beans and oats usually perform this function on heavy land, and oats, rye or barley on light land.

Specimen Guide Mixtures

Various proportions of cereals to legumes are used in different parts of the country, and there would appear to be no standard formula that will suit all conditions. The following mixtures, which have been grown successfully on various types of soil in Yorkshire , may serve as a guide:—

Average Soils. Light Soils. Heavy Soils.

***Stones per acre. Stones per acre. Stones per acre* .**

Oats, 10 Oats, 10 Oats, 8

Tares or peas, 4 Tares, 2 Beans, 4

Peas, 2 Peas & Tares, 4

In the southern half of the country the crops are usually sown in autumn, but in the north a spring sowing is generally more successful. Fortunately both winter and spring tares are available, and this valuable plant can, therefore, be included in all mixtures, which is useful, for it will give a good aftermath for cutting or grazing.

Where beans are included in the mixture they should be ploughed in about a fortnight to three weeks before sowing the oats and tares. This gives them a slightly longer growing season and places them out of reach of birds.

Care with Beans

In this connection it is well to remember that, unless means are available for chopping the crop or it is to be ensiled in a pit where good consolidation can be obtained, the inclusion of beans is

undesirable. The stems become strong and fibrous and tend to keep the material rather open or loose when packed into the silo. Good consolidation is, therefore, difficult to obtain; high temperatures are recorded, and the digestibility of the silage obtained is correspondingly low.

If the mixture is sown in autumn it can be grazed down in spring, and then top dressed with nitrogenous fertiliser to produce a silage crop.

With all cereal-legume mixtures it is useful to sow from 10 to 20 lb. per acre of Italian ryegrass, for this will produce excellent autumn grazing or a late cut for silage. Moreover, should a spring cereal

follow the silage crop it will be possible to graze the ryegrass through the winter and get an early spring bite before the field need be ploughed in

readiness for drilling the following crop.

Better even than ryegrass, is a mixture of Italian ryegrass (10 lb. per acre) and trefoil (4 lb. per acre), for trefoil is one of our earliest spring plants and gives a good grazing for ewes and lambs or even milking cows at a time of year when keep is so frequently scarce. It is not generally realised that a cereal-legume mixture forms an excellent nurse crop for "seeds" The thickness of the crop is not harmful, for it is removed early in summer before it can exert a smothering effect, and this permits the early grazing of the young grasses and clovers that is so beneficial for good establishment.

For Undersowing

Another mixture that is very valuable for under-

Another mixture that is very valuable for under

sowing in a silage crop is rape 4 lb., broad red clover 2 lb., and Italian ryegrass 10 lb. per acre. This provides a very good flush for ewes at tupping time, some valuable autumn grazing, and an early spring bite. Should the silage crop be autumn-sown, any "catch crops" will naturally be sown in spring when soil and weather conditions are favourable. The best procedure for a spring-sown silage crop is to drill the cereal mixture and harrow it in, follow this with the ring roller, drill the grass mixture and then finish by harrowing and rolling.

Frequently on light land the oats will be omitted and rye substituted in their place and in trials conducted in Essex a mixture of 2 bushels of tares and 0.5 bushel of rye per acre gave good results. Rye is apt to be coarse fodder and difficult to ensile without the aid of a chopper except in a pit.

A Suffolk farmer who has made pit silage for the

last twenty-five years has adopted the practice of cutting the silage mixture into the stubble in late September with a disc drill without ploughing. His mixture consists of 1.5 bushels of tares with 10 lb. of Italian ryegrass or 1.5 bushels of oats.

At the Hannah Dairy Research Institute a mixture of barley, peas, tares and Italian ryegrass has given very promising results, being cut four times and then grazed. The first cut was composed entirely of barley, the second cut half barley and half peas, the third cut barley, peas and tares, and the last crop mainly ryegrass.

Cereal-legume crops are generally cut for silage when the cereal has reached the so-called "milky" stage and the legume is well podded. At this stage

of growth the crop has an adequate supply of carbohydrate to produce the necessary acid fermentation, and the crop can be ensiled without

molasses.

Of recent years there has been a tendency for such crops to be cut at a much earlier stage, with the object of securing a richer type of feed that can be considered as a "cake-substitute."

The adoption of this policy generally leads to a considerable reduction in yield, and for most purposes the wiser policy is to cut at the normal stage and thereby gain the maximum yield of fodder per acre. Far better to rely on grass and clover for "quality".

The average yield of cereal-legume silage is in the

region of 8 tons per acre, although on land in good heart and with generous manuring a yield of 14 tons of silage per acre is quite common.

Grass and Clover Mixtures

In the production of high quality silage on arable land, grass and clover mixtures have decided possibilities. The following well-tried mixture, for instance, when sown on good land, will give three cuts for silage in an average season, yielding from eight to nine tons of silage per acre.

Western Wolths or Express Ryegrass . 30 lb.per acre.
Perennial Ryegrass . . . .10 lb.per acre.

Broad Red Clover . . . . 4 lb per acre.

The mixture will remain productive for two seasons, although a slightly lower yield must be expected in the second year. Also worth trying:—

Italian Ryegrass . . . . 6 lb. per acre

Broad Red Clover . . . 8 lb. per acre

Dutch White Clover . . . 2 lb. per acre

Trefoil . . . . . 2 lb. per acre

If this mixture is sown under a cereal nurse crop it will give good autumn grazing after harvest and an early bite the following spring. After grazing down a top dressing of sulphate of ammonia or nitro-chalk will produce two good cuts for silage.

A mixture that will give a bulky crop of highly nutritious herbage and will hold the land for five to six years is:—

Cocksfoot . . . . 10 lb. per acre.
Lucerne 15 lb. per acre

It should be sown on clean land in good heart and in order to ensure a good "take" of lucerne, a generous application of phosphates should be given before seeding.

Maize

Maize is the most favoured crop for ensilage wherever it can be grown successfully. In England it is regularly grown in the southern and eastern counties where high temperatures and freedom from late spring frosts enable the crop to reach a

reasonable state of maturity for ensilage.

Compared with other arable crops it produces by far the greatest yield of silage per acre when grown under favourable conditions. The crop is cut towards the end of September when the grain is in a pasty condition, and, being essentially a carbohydrate type of food, does not require the addition of molasses.

A Maintenance Food

Owing to the thickness of the stems, chopping is

Owing to the thickness of the stems, chopping is essential to ensure good packing in the silo, and the product must be regarded as essentially a maintenance food.

Sowing must be deferred until all danger of frost is

over, for the crop is very sensitive to low temperatures and, whilst the preparation of the land and manurial treatment will vary according to the type of soil and locality, it is well to remember that this crop is a gross feeder, requiring generous treatment.

In recent years, early-maturing varieties most suitable for conditions in this country have been introduced, notable ones being " Compton 's Early," "Early Learning" and "Eureka." In many districts birds are a pest wherever they find the crop has been sown, and it is advisable to string the field.

Marrow Stem Kale

Few crops can compete with kale for ease of

growing and high yield of crop. Like maize, it is a gross feeder and does best on land in good heart, but here the comparison with maize ends, for kale can be grown successfully in all parts of the country and produces a much more protein-rich silage.

The crop has now attained great popularity throughout the country, particularly on dairy farms, but, until recently, few farmers have attempted to convert the crop into silage. No doubt this has been due in large measure to the fact that it can remain growing until required for feeding, which after all is the cheapest way of utilising it. In certain districts it will stand through the winter, but as a general rule it is consumed as far as possible before severe frosts set in

before severe frosts set in.

For Late Winter

The need for a greater measure of self-sufficiency on farms has now brought kale to the forefront as a heavy-yielding crop for winter feeding, and many are contemplating its conversion into silage. As such it would be useful for late winter feeding, while the crop would be carted off before winter rains make fields and gateways soft, or before wood pigeons strip the plants bare.

Fortunately, in the last two years, we have had a good deal of experience of the possibilities of making kale silage and, provided the crop can be chopped for filling into the silo, it will produce an excellent winter food.

There is no need for the addition of molasses,

although I have frequently found that where molasses has been used a rather better type of product has been obtained. If the crop is left growing until late in the season before ensiling the stems become fibrous or even woody, and it is advisable, therefore, to convert the crop into silage in early autumn when the plant is more tender, more leafy and less stemmy.

A further advantage attached to early cutting is that it liberates the land for an autumn-sown cereal crop.

If kale silage is contemplated, it is a good plan to cut as much as is required for this purpose in September and then to use the rest of the crop direct from the land in the usual way. The silage can then be used when the fresh crop is finished.

A strong type of silo is necessary, owing to the great outward pressure exerted by this crop, and if molasses is used it should be diluted with an equal

molasses is used it should be diluted with an equal volume of water, being applied at a rate not exceeding 3 gallons of solution per ton of crop.

Rape

Like kale, rape makes good silage without the need for molasses, although, here again, the addition of molasses may be helpful in promoting a better type of product. With rape, however, chopping is unnecessary.

As a rule kale will be preferred on account of its higher yielding properties, but in some instances grass seed mixtures may be sown down under rape, and should the crop be surplus to folding

requirements it is better to convert it into silage than allow the rape to become strong in growth, when it is apt to smother the young grass and clover plants. The silage has a pleasant well-liked nutty flavour.

nutty flavour.

By-Product Silage Crops

On most farms in most seasons there comes a time when some crop or other is surplus to the immediate needs of the stock, yet it is of such a nature that it will not retain its fresh condition indefinitely. Ensilage offers a means of preserving this surplus in a succulent condition with little loss of feeding value, for use at a later date; when in all probability there will be a shortage of food.

War-time conditions demand full utilisation of all surplus crops on the farm, and as soon as it is apparent that there

is likely to be more of a certain crop than can be used fresh it should be cut for silage. Delay will generally mean a considerable lowering in the feeding value of the crop.

Sugar Beet Tops

Sugar beet tops make excellent silage that forms a

useful substitute for roots, having the same feeding value for all practical purposes as swedes and mangolds.

On farms where there is a good acreage of beet, and lifting continues from October to December, the tops can usually be fed off " fresh " by sheep or carted to other stock on pasture or to bullocks in yards. This is undoubtedly the most satisfactory way of utilising them, but should the supply of tops be in excess of immediate requirements the supply

should be ensiled for use at a later date.

Ensile Best: Fold Rest

Where there is a heavy crop of beet tops it is a good plan to cart off the cleanest and best of them for silage and leave the remainder for folding, for when they are thick on the ground the sheep will waste a considerable quantity by treading them

into the land. The probable surplus can be estimated roughly by assuming that there will be a ton of tops for each ton of roots, and that one acre of tops will last a hundred ewes or sixty cows for a week. To plough the tops in as manure is wasteful, since the manurial value per ton is only a fraction of their feeding value.

A prime necessity before good silage can be made

from beet tops is that they should be clean and free from soil. Disappointing results when tops are ensiled can almost always be traced to this factor, for when dirty tops are packed into a silo great numbers of undesirable bacteria are introduced at the same time.

As topping proceeds, it is a wise plan to put the tops into small heaps so placed that carts will not pass over them when taking off the beet. Many farmers make a practice of carting all the tops they

require for ensilage before the beet itself, and this certainly helps in keeping them clean. If possible they should be ensiled within ten to fourteen days of topping.

Container for Small Quantities

Should only comparatively small quantities of tops be available it is advisable to use a container of some type, either home-made or purchased, but for large quantities the pit or clamp method is undoubtedly the best, since it permits good consolidation by carting over the top of the heap. In this connection it is essential to see that the carts are clean, for it is of little use taking care to keep the tops clean in the field if every time the cart is taken on to the heap many pounds of soil are taken with it.

Indiscriminate consolidation is a sure means of producing bad silage, and it is necessary to ensure

producing bad silage, and it is necessary to ensure that each three-foot layer of tops added to the silo shall be allowed to heat and settle before adding more. Should the tops be wet when ensiled it is a good plan to mix with them some straw chop or chaff, provided the quantity added is not sufficient to make the heap spongy. The tops contain sufficient sugar for the rapid production of the necessary acids, and the addition of molasses is, therefore, unnecessary.

Mangold Tops

Mangold tops can be dealt with in the same way as sugar beet tops, but they are not so easy to collect in the field, since no crown is left, while the yield is not nearly so large as with the sugar beet crop. On small farms that are heavily stocked, and where the last ounce of food must be extracted from the land, mangold-top silage will form a useful substitute for roots. On most farms, however, the difficulty of

collecting the tops, combined with the low yield per acre, will rule out the possibility of ensiling them, on economic grounds. Molasses are not required for ensiling mangold tops, and the product is not so valuable as that made from the tops of sugar beet.

Turnip Tops

Good silage can be made from turnip tops if care is taken to keep them clean and to make sure that the requisite degree of heating is allowed to develop. Owing to the high water content of the tops care is necessary to avoid over-consolidation. The addition of molasses is a wise precaution, for though it is not essential, it aids the rapid production of lactic acid. A dilute solution made up from one part of molasses to two parts of water should be sprinkled on each 6 in. layer at the rate of 3 gal. per ton of tops.

If grass is available at the time of ensiling it can be mixed with the tops with advantage. Well-made turnip-top silage is virtually a balanced ration for milk production, and is well worth making, particularly on small, heavily-stocked dairy farms.

Potatoes

Potato silage as a food for pigs is used to a considerable extent in many Continental countries. The tubers are first steamed in specially-constructed wooden boilers and when cooked are packed into pit silos that are usually lined with concrete. The silo is made sufficiently air-tight with a good covering of soil, and in this way the potatoes can be kept in good condition for many months, with very little loss in feeding value.

In recent years many steaming plants have been installed in this country in order to utilise potatoes

installed in this country in order to utilise potatoes for pig feeding. The chief drawback experienced by those who use their surplus potatoes in this way is that when once cooked potatoes soon turn sour, so that steaming becomes a routine job demanding a good deal of labour. The method of ensiling should appeal to all these farmers, for by adopting it they may steam the whole stock in the shortest possible time, pack the cooked potatoes into the silo, and then use the silage as and when required. The silage is ready for use as it comes from the silo, and, in addition to the advantage of convenience, all losses that usually occur in a clamp owing to the presence of damaged tubers can be avoided, for the steaming would be carried out at the beginning of the season.

There is no doubt that if the method became common, contracting firms would obtain suitable steaming equipment that could travel from farm to farm after the manner of threshing tackle.

farm after the manner of threshing tackle.

The potatoes should be fairly clean before steaming. When cooked they are tipped into a pit silo and pounded into a solid mass whilst still hot, but if preferred, wooden or concrete portable silos can be used. As a rule one tier of these silos is sufficient, for the weight of the crop is considerable, and to carry the silo any higher necessitates heavy lifting and slowing down of the process.

When full, the silo should be covered with bags to keep the tubers clean, and then with a good layer of soil to make it airtight. If the silo is exposed to

the weather it will be necessary to make it watertight as well as airtight, by erecting a roof over it or by rough thatching.

Up to 12.5 lb. for Pigs

Many of the tubers contain both large and small

Many of the tubers retain their shape and the silage has a definite smell of lactic acid, being somewhat like buttermilk in taste. Experiments carried out by the Midland Agricultural College suggest that 3.25 lb. of potato silage is equivalent in feeding value to 1 lb. of cereal meal ; and that pigs weighing from 115 to 200 lb. may be given up to 12.5 lb. daily in addition to an allowance of meal.

Thus, under the present conditions of limited supplies of feeding stuffs, especially for pig feeding, farmers who have boilers for steaming

potatoes, or sterilising equipment that might be adapted for the purpose, will do well to try potato silage.

Good silage can be made from potatoes without first steaming them if they are mixed with a green crop such as young grass or clover. Alternate layers of grass and potatoes are packed into the

silo sandwich fashion, and the heat developed during ensiling will partially cook the tubers. The resulting silage is excellent for milking cows and the combination of carbohydrate in the potatoes and protein of the grass will produce what for all practical purposes is a balanced ration.

No special precautions are necessary during ensiling, other than the careful treading of the green material, and the use of molasses is unnecessary.

Pea Haulms and Pods

In many districts peas are grown for canning or direct consumption. When they are grown for canning the farmer usually delivers the crop to the factory, where they are threshed, or, as it is termed, vined, and the returning lorries cart back the haulms and shelled pods. Frequently this will be spread on the field and ploughed in or merely

be spread on the field and ploughed in or merely left in a heap to rot. Many factories purchase their peas after picking, and then the pods constitute the waste. The return of the pods is not part of the contract, and farmers in the immediate vicinity of the cannery can usually obtain the pods for the cost of carriage.

When picking takes place in the field the haulms are left and are generally made into hay, but this is frequently very unsatisfactory, for, unless good weather for haymaking prevails at the time, the pea haulms will tend to be damp and will mould in the stack. Often the crop will never reach the stage of fitness at which carting can safely be contemplated, and there is no doubt that the surest means of utilising either pea haulms or pods to best advantage is to make them into silage.

No special difficulties will be experienced in making silage from these by-products. With the

making silage from these by-products. With the haulms the great difficulty is to ensure adequate packing, for the material is rather springy and may easily overheat. If a chopper is available this difficulty does not arise, nor is it so likely to occur when the haulms are vined at the factory, where the stems are generally well broken in the vining process. If picking takes place in the field it is important to cart the haulms away for ensiling as soon as possible.

If, as sometimes happens, picking takes place during very hot weather, up to 5 gal. of water per ton of crop may be sprinkled on the haulms as they are being packed into the silo, to counteract the loss of moisture in the field.

No Molasses for Pea Haulms

As a rule, no difficulty will be experienced in getting adequate consolidation when the pods

alone are used. More frequently the danger will be in the opposite direction, and one must be careful not to overdo the treading, but to allow each layer

to heat up before adding more pods. There is no need for the addition of molasses either to haulms or to pods.

When the pods are used a good deal of seepage takes place, and if some mature grass or even chaff can be mixed in with them it may be used with advantage to absorb the surplus moisture. Without something to absorb the sap that is squeezed out, it will collect round the silo, turn sour, and become a source of annoyance. In one instance the author found a portable wooden silo designed to hold fifty tons of normal silage packed with ninety tons of pea pods, and the silo in a sea of effluent!

Pea haulm silage has invariably a sweet fruity smell and is much relished by stock. In pea pod

silage the pods will lose a little colour but otherwise will be unchanged, and although the silage is very palatable it contains a high fibre content. Pigs, for instance, spend far too much time chewing it and throwing out the wads of fibre.

Apple Pomace and Brewers' Grains

Of the less well-known by-products apple pomace and brewers' grains deserve mention, for both can be ensiled successfully. Apple pomace is low in protein but rich in carbohydrate, and does not, therefore, need molasses when ensiled. By reason of its condition it packs tightly into the silo, necessitating some care in filling. The product has been given to all classes of livestock with good results.

Fresh brewers' grains may also be ensiled, either alone or with other crops. The material, however,

alone or with other crops. The material, however, soon moulds and ensiling must, therefore, be done rapidly. As a rule pit or rigid wall silos are to be preferred on account of the great pressure exerted by the material, which packs very tightly.

Handling the Crop

In handling any green crop for ensilage the paramount need is to get it to the silo in as fresh condition as possible. Just as it is desirable to "make hay while the sun shines" so one should endeavour to "make silage while the crop shines."

Young grass is likely to present more difficulties than most crops cut for silage. When 6 to 8 in. long, however, it is easily cut with an ordinary mower, and if raked in the direction of cut, taking one swathe at a time, it can be

collected with the hay rake.

The grass should not be cut too near the ground: if a one

or two-inch stubble is left the crop will recover from cutting more rapidly, and in hot weather is not likely to scorch so badly. A side delivery rake is even better, making a clean job of windrowing, from which it can be collected by hand into bogies or carts with four-pronged forks. At first sight it seems a slow job, but it is not a skilled job and schoolboys or other unskilled workers can be utilised for this purpose.

Implements for Collecting

A combined cutter and collector with a trailer attached, such as the "Wilder Cutlift" or the Shanks' "Cutter Collector" is ideal for the job of dealing with short crops. Two devices for attachment to the mower have recently

been introduced. One enables the cut grass or other crop to be left in a windrow instead of a swathe, and the other carries the cut crop and leaves it in heaps on the principle of a sheaf-carrier on a binder.

Many farmers have tackled the problem themselves and have fitted a tray behind the cutter bar of the mowing machine. A man with a hand rake follows the mower and pulls the crop off in heaps as it collects on the tray. The old type of "put-off" reaper, with seating accommodation for both the driver and the man with the rake performs good work, and many of these old implements can be reconditioned for silage work.

The employment of a special steel sweep for heaping up the short grass is another useful way of dealing with short stuff. Instead of the usual wooden teeth set about a foot apart, the tines of this implement are set close together,

and are made of spring steel, the width being sufficient to take two swathes at a time. The grass is left in heaps and can be collected in the usual way.

Certain types of hay loader can also be fitted with attachments for collecting short crops, and the use of these various attachments and implements will not only speed up the work but also reduce the cost of collecting

speed up the work but also reduce the cost of collecting.

Unloading at the silo is also rather laborious and often regarded as a "man-killing " job. There is really no need for this description, for the art of making good silage depends upon careful and even filling of the silo, the men in which cannot perform their task efficiently if large forkfuls of tangled material are heaved at them. Thus the rule should be " small forkfuls and often."

Unloading is considerably simplified if an elevator is

available. Care must be taken, however, to keep the elevator chain fairly tight otherwise the weight of the green crop bearing on the spikes of the elevator rakes will tend to twist them backwards and allow the crop to fall off. With short grass any tendency for it to fall between the spikes of the rakes can be overcome by fixing lathes of wood or even strips of sacking across them.

A Tip for Unloading

To facilitate unloading at the silo when an elevator is available a very useful dodge is to lay three heavy cart ropes equally spaced along the bottom of the cart before loading. These should be brought together at the front of the cart and fixed to a hook or ring allowing a good length of rope to hang down in front of the cart. The cart is then filled, and on arriving at the silo a long rope is passed over the load from the back and attached to the hook in front.

By pulling on the rope with a tractor or trace horse the complete load can then be rolled off, liberating the cart for another load.

Whereas a crop of short grass is difficult to deal with because it is short and small in quantity, a heavy crop of oats and tares can be equally difficult because of its length and bulkiness. Very frequently, it will be difficult to cut, but it is the raking up that is the most trying job. Horse rakes are unable to cope with green material, but the put-off reaper, already mentioned, will save a good deal of work by leaving the crop in heaps.

work by leaving the crop in heaps.

Adapting the Binder

The binder can be used successfully in such crops, and the green sheaves will be found very handy to collect, although to use a binder in this way can be hard on the

canvasses. It has been suggested that the binder might be used as a cutter-loader by removing the binding mechanism and running a low trolley alongside the binding deck. The grass will then be cut, elevated by the canvasses on to the binding deck whence it will slide down into the cart or trolley running alongside. A man with a rake is necessary to help the material to slide.

Until recently the apathy shown by farmers towards silage has not encouraged engineers to tackle the many problems connected with the harvesting and ensiling of these green crops, but with more assured prospects for the process it is likely that new implements and methods will be devised shortly for speeding up the work and

cutting out the more irksome and heavy hand labour.

When a tower silo is used the crop has of necessity to be chopped and blown into the silo. This does not mean that

a cutter and blower has no use in connection with the smaller type of portable silo— it has already been pointed out that to chop the crop has decided advantages.

Many have experienced the comparative ease with which good silage can be made from, say, aftermath grass in contrast to the difficulties encountered when a long and coarse crop like oats and tares is ensiled. With the grass a light-brown silage is invariably obtained, denoting that the temperature has been maintained at the correct level, whereas with the oat and tare crop, it is seldom that one achieves other than a dark-brown silage when it is ensiled in a small silo without chopping.

It is, of course, the old problem of getting adequate consolidation. The short grass packs readily, whilst with

the other crop air cannot be excluded sufficiently and the temperature rises above 120 degrees Fahrenheit. Much

can be done by simple means such as chopping the crop when in the silo with a sharp spade or hay knife. The work is hard, however, and can never be a substitute for the efficient mechanical cutter.

Cutters and Blowers

There are two main types of cutter and blower. In one, the knife and the blower are fixed together but in the other they are separate. Each type has its adherents, and the choice must be left to the individual, but both are efficient machines. They are fitted with automatic feed safety clutches, the length of cut is variable from about 1.25-in. to 1.5-in., and the capacity varies from 6 to 12 tons of green fodder per hour, but this is dependent upon the length of cut, condition of the crop, the amount of power available, and the manner of feeding. The delivery pipe is built up from a number of short lengths and can therefore

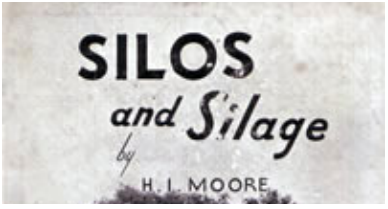
be varied to suit the height of the silo.

In view of the increased tonnage of silage that is likely to be made in the future, cutters and blowers are being made available in all districts, where they' will travel from farm to farm as required, like the threshing outfits so long common to every district. Farmers are strongly advised to avail themselves of the opportunity of employing them when possible, for not only is better consolidation obtained when coarse material is chopped, thereby giving a better quality product, but the capacity of the silo can be better utilised. To obtain a better quality product and at the same time pack more material into the silo is well worth consideration.

The problem can also be tackled by the simple measure of mounting a hay chopper on a stage at the top of the silo. The chopper should have one blade removed and can be

driven by a small stationary engine or electric motor. The crop is then forked on to the staging, fed to the chopper,

and falls from there into the silo. A suitable layout is shown in Plate II.



CHAPTER IV

Illustrations

Types of Silo

"What type of silo shall I buy?" This is a question every farmer asks when once he has decided to embark on the new venture. The introduction of new methods of silage making has inevitably resulted in the production of a large number of different types of silo, which bear little resemblance to the tower silos considered necessary

years ago.

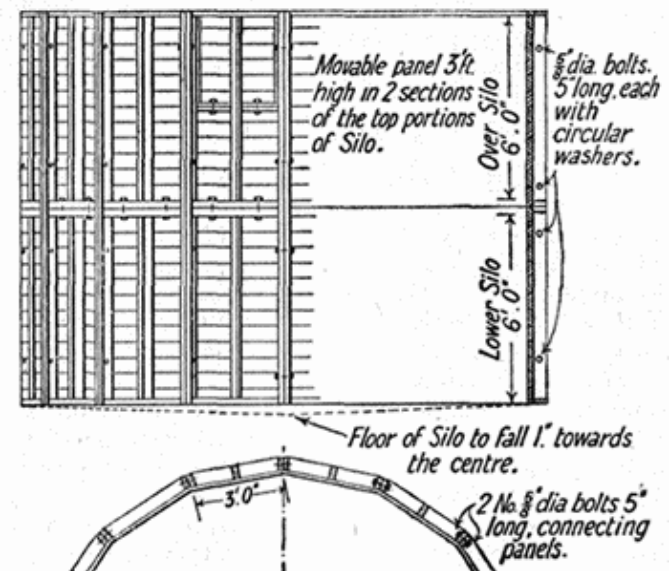
The present trend is for simplicity, cheapness, and portability in silo design, and there is a wide range of choice, from simple temporary structures costing a few pounds to the more elaborate and permanent types costing three or four times as much.

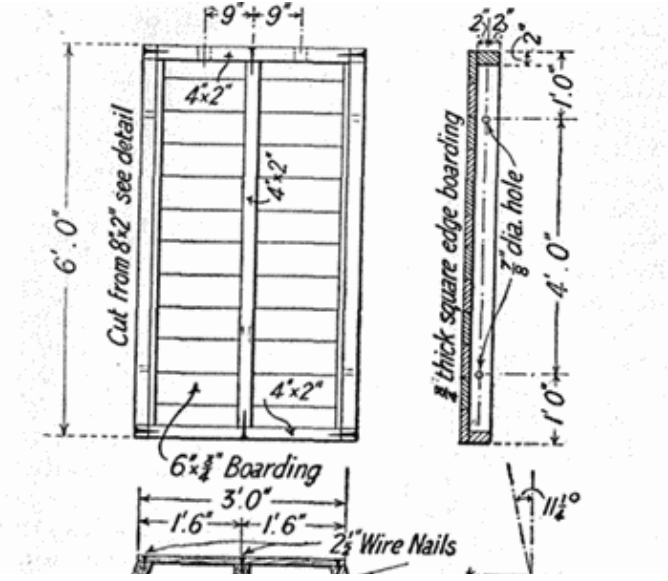
Even a small expenditure is unnecessary, however, for any handyman can contrive a silo from existing buildings or materials, and can produce excellent quality silage in it, provided the essential points of silage making are strictly adhered to. The method of making silage counts more than the type of silo used.

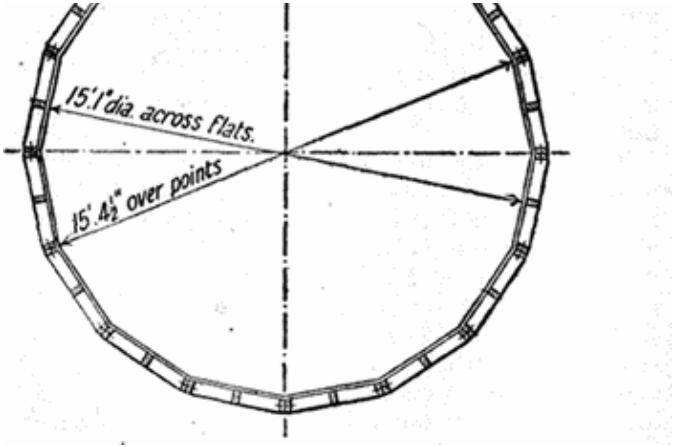
To obviate the difficulties inherent in the manufacture of circular structures, most modern silos are built in sections that bolt or clamp together to form a polygon. This particular type of silo was introduced by Messrs. I.C.I., Ltd., in 1932, and has proved most serviceable and economical. In fact, the particular design of the I.C.I. silo

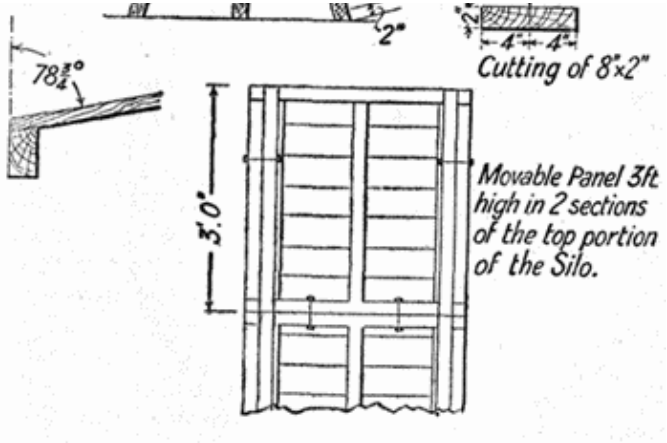
can be easily constructed on the farm. It is usually made of wood creosoted under pressure, and no fear need be felt on the score that the acids in the silage will cause decay, for they are themselves wood preservatives.

Specification of I.C.I Silo









Many wooden tower silos, for instance, are still in excellent condition after 30 years.

With some polygonal silos cheapness has been obtained by using asbestos or composition on a wooden framing in place of the normal inch or three-quarter inch boarding. This does not, of course, give such a permanent structure.

Concrete is equal favourite with wood in the construction of silos, and many sound designs for concrete structures are on the market. Some of these are built up of large

panels each weighing about 70-150 lb., which are bolted together; some are made from small blocks which slot into grooved uprights; whilst others are built up from self-locking and self-aligning units that eliminate all metal or other fittings. Here again, it is possible to build one's own

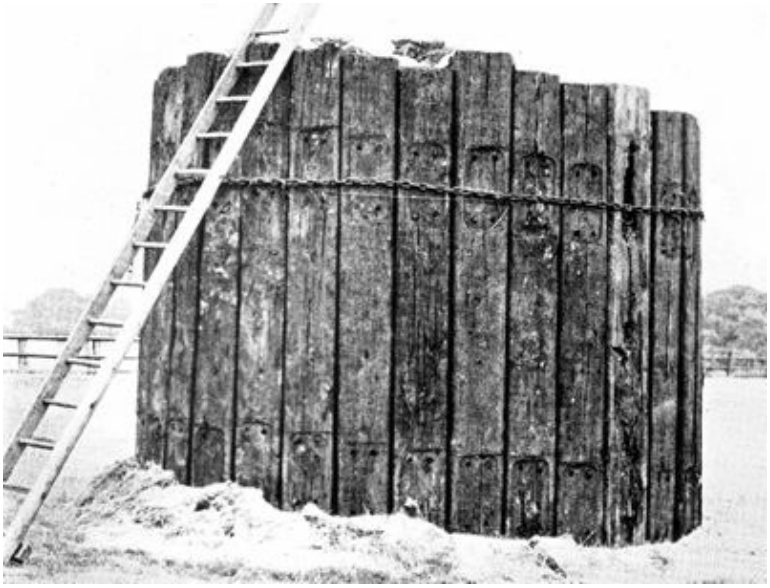
concrete silo from small or large blocks, once a suitable mould in which the units are cast has been made, but as a rule most farmers will prefer to buy one of the standard makes.

Bricks, of course, can also be used for building a silo, but if so the building must be cement rendered on the inside to counteract the porosity of the bricks.

Wood or Concrete

There is very little to choose between the wooden and concrete types of silo, and each

types of silo, and each has its staunch adherents. Wooden silos have the advantage that the sections are lighter in weight and one man can easily erect them. There is no danger of the panels cracking should they be roughly handled, nor will the corners break off. On the other hand, a well-made concrete silo is a permanent structure and should not require any attention for many years. Each man must, therefore, make his own choice after carefully studying the literature

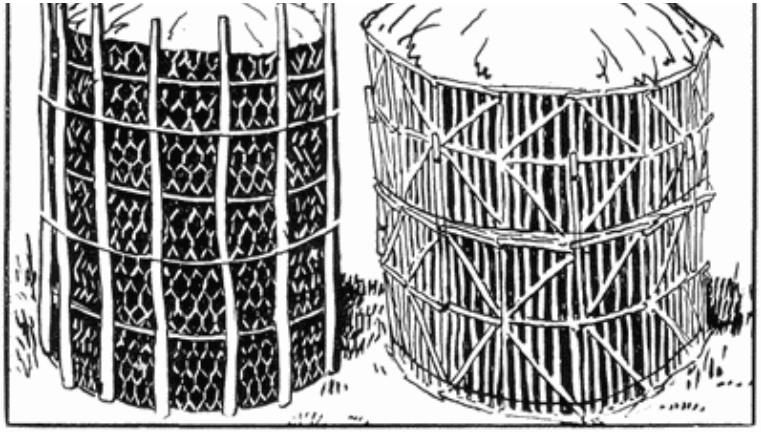


from the manufacturers, always keeping in mind the fact that with silos, like most other farm implements, the best is cheapest in the long run.

A Silo made from railway sleepers

Less permanent but cheaper containers are sisal paper-lined or treated felt-lined silos, the outer structure consisting of a circle of suitably joined steel wire or wooden pale fencing. Tier upon tier can be erected as in the more permanent

structures, and although the lining material must be replaced each year, the outer support will, with reasonable care, last for several seasons. The author has used silos of this type for the past four years and the supporting material is still in regular use and in good condition.



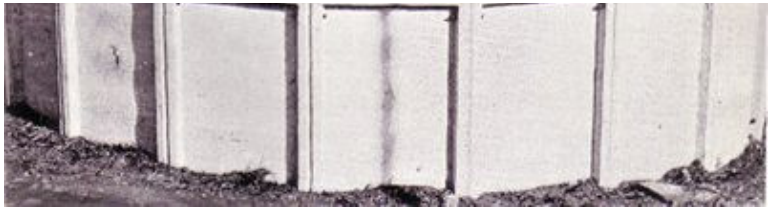
A Farmer & Stock-breeder's

artist's impression of (left) an improved wire netting silo and (right) a hurdle

silo. Both well topped up.

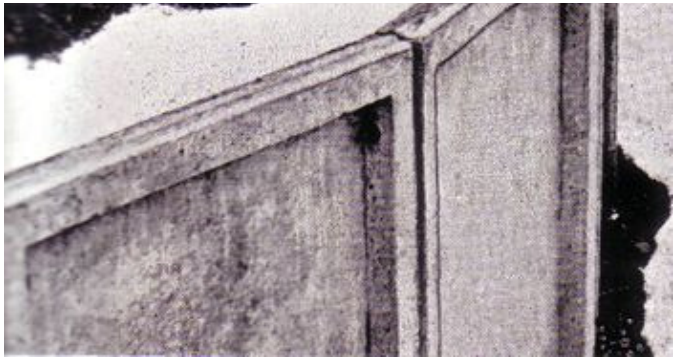
Filling two silos on laternate days allows time for each layer of crops to heat up.

Between fillings plenty of weight should be

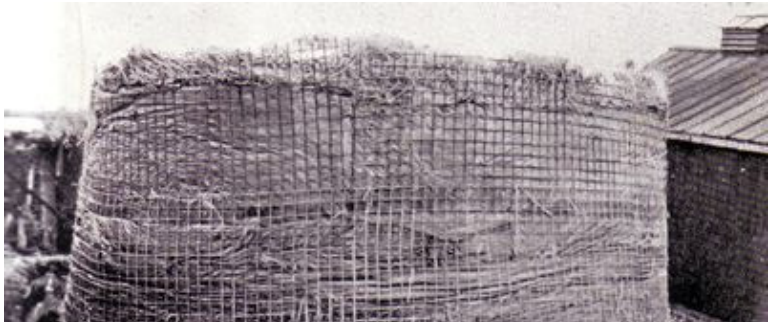


placed on top to prevent over-heating.

The silo wall forms a gutter and allows the

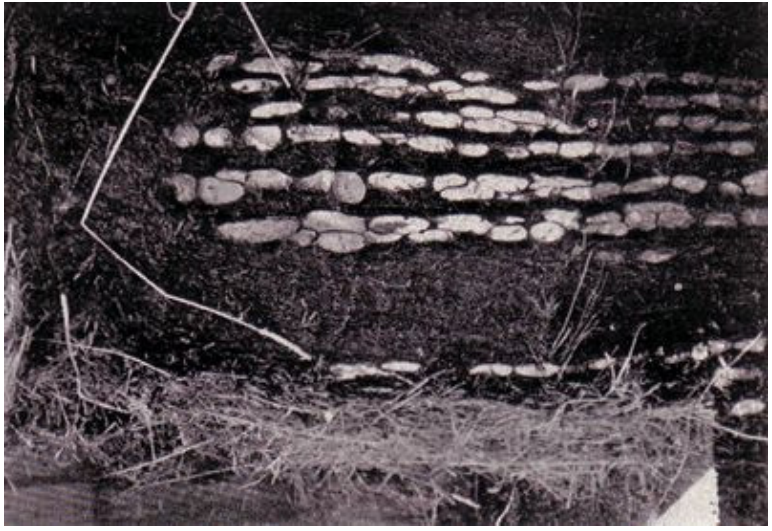


wet to seep down inside the silo thereby causing waste



Failure to level the site results in twisted and bent wires and torn paper

paper



Potatos mixed with young grass to produce a well-balanced silage for milk production

To remove the silo and cut out the silage in this way allows air access and results in undue waste

Silos for Moving

This type can be easily transported, is erected quickly, and

This type can be easily transported, is erected quickly, and will be found very useful when the permanent silos are full to capacity and additional fodder is still waiting to be ensiled. As might be expected, much greater care is

necessary when filling them, especially if long and coarse fodder is being used, and a good deal of attention must be paid to levelling the site on which they are to be erected.

Of still more recent manufacture is an ingenious silo made from flexible asbestos sheets held together with wire. The sheeting is waterproof, fireproof and rot proof; is light in weight, very tough, and when not in use the sections lie flat and can be stored in little space. Silos of this type vary in size from ten to fifteen feet in diameter. The sheets from which the silos are constructed each weigh 39 lb. and measure 8 ft. by 4 ft. by 1/8 in.

Another easily constructed silo takes the form of a specially woven fabric of vegetable fibre that serves as a support for several coatings of plastic cement. When the fabric is impregnated with the liquid concrete, which is

fabric is impregnated with the liquid concrete, which is applied with a brush, a thin but rigid wall is produced.

Several applications are made until the requisite strength and thickness has been obtained. Construction of this silo takes place under licence from the patentees, and a 20-ton silo will cost in the region of £5.

Improvised Silos

Serviceable silos can often be constructed with a minimum of expenditure from materials found on the farm. Hurdles, wire netting, corrugated iron sheets, old buildings and even bales of straw can be used for this purpose.

In making silos from these materials certain basic principles must be kept in mind. The silo must be reasonably air-tight, and sufficiently strong to withstand great pressure from within. The inside walls should be smooth or the crop will cling to the edges and pockets of air will be formed, and as a rule a circular structure will be more convenient to fill than a square or rectangular one

more convenient to fill than a square or rectangular one. In the latter types sufficient packing in the corners always presents some difficulty. When the silo is not made of airtight materials a lining of felt or sisal paper is necessary.

With most home-made silos the chief danger to guard against is bulging, to prevent which strengthening wires should be fixed round the outside of the container. Even with an old building it is necessary to make sure that the walls are strong enough to withstand the pressure. In addition, old walls must be made airtight and if necessary smoothed down with a cement rendering.

Very serviceable silos can be made from galvanised corrugated sheeting. Standard sheets are usually 8 ft. by 2 ft. 4 in., and the diameter of the silo can be varied according to the number of sheets put into the circle. The

sheets should overlap two corrugations and be bolted in four places. If the silo is set in a bed of concrete, and is steadied by four substantial posts on the outside it makes

steadied by four substantial posts on the outside it makes an excellent job.

As a precautionary measure against corrosion it is advisable to paint the walls both inside and out with a good bituminous paint, and any tendency to bulging should be checked by passing a chain or wire round the outside. The need for preventing bulging must be stressed, because wherever this takes place air pockets are formed, resulting in mouldy silage.

A very cheap and substantial silo can be made from railway sleepers stood on end side by side to form a circle. They should be let into the ground about a foot, lined with sisal paper or felt, and supported or prevented from bulging by a chain or rope round the middle.

Deciding on Site

The size of silo is a factor of considerable importance, and in deciding upon the dimensions one must take into consideration both the amount of silage that is being

made, and the amount that is likely to be used daily.

Silos should never be too large, and in practice it will usually be found much better to have two medium-sized silos rather than one very big one. It is true, of course, that the same amount of storage capacity can be secured more cheaply in a silo of large diameter than in two small ones with the same total capacity, but as will be seen later, the drawbacks attached to the use of a very large silo more than outweigh the saving in cost.

It is well known that the green crop settles considerably when packed into the silo, and constant re-filling is

necessary in order to get it completely filled. The top few feet of space are very difficult to fill and the use of an "over-silo" is generally necessary. This merely consists of a removable structure of wood or posts and wire netting lined with paper, which can be erected on top of the silo proper. The over-silo is filled, and after the crop has settled (to the top of the main silo) it can be removed.

To Avoid Re-filling

The same result with much less trouble can be obtained by using an extra tier of the silo as an over-silo. Without the use of an over-silo the silo itself must be at least 10 ft. in depth (two to three tiers), so that after the material has settled the top tier can be removed to enable the silo to be sealed ; but by using a temporary superstructure one to two tiers alone (5 ft.) can be used.

The usual diameters for small, portable silos, range from 9 to 21 ft., and, in choosing a silo, one of the first points to bear in mind is the fact that it is difficult for two men with forks to work in a silo only 9 ft. in diameter. A lot of farmers prefer, however, to spread the crop by hand, arguing that by so doing better shaking up and more even spreading is obtained, and in such circumstances the drawback of the small diameter for working space does not arise.

The following table shows the approximate capacities in tons for silos of varying size when filled with grass. The figures given refer to the finished product and not the green crop. Where the capacity of the silo in terms of green crop is required these figures can be increased by 25 per cent. :—

TABLE 1 relationship between diameter and capacity

Height of Silo	Diameter of Silo in feet				
(feet)	9	12	15	18	21
5 (1 tier)	5	I0	I5	22	30 Tons
6 (2 tiers each 3 ft.)	7	12	19	27	37 „
8 (2 tiers each 4 ft.)	9	16	25	36	50 „
10 (2 tiers each					

10 (2 tiers each 5 ft.)	10	20	30	44	60 „
12 (3 tiers each 4 ft.)	13	24	37	54	75 „
15 (3 tiers each 5 ft.)	15	30	45	66	90 „

In comparing the prices of different silos from makers' specification, care should be taken to ascertain whether the figures given refer to the capacity of the silo in terms of finished material or of green crop. What is described as a 30-ton silo may mean that it holds 30 tons of green crop and not that 30 tons of silage will be obtained from it.

The best diameter of silo to use is determined by the amount of silage likely to be used per day. This, in its turn, depends upon the head of stock and the quantity of silage given per head.

In emptying a silo two methods are commonly employed.

In emptying a silo two methods are commonly employed. The first and best method is to start at the top of the silo and remove a layer each day or perhaps every other day, sufficient for the requirements of the stock. The second method is either to remove the silo walls to leave merely

the stack of silage, or to remove one or more sections, to enable the silage to be cut out in wedges, cake fashion, with a hay knife. By removing a layer each day no time is allowed for moulds to develop, whereas, by cutting out wedges, even if they are taken from alternate sides every day, air inevitably penetrates into the material and moulds develop.

To remove the entire silo at the outset will increase this Waste. It is urged, therefore, that the first method be adopted, and, if so, the diameter of the silo should be such that a layer two to three inches in thickness will provide the daily requirements of the stock.

The following table gives the weight of silage per inch of depth for silos of varying diameter. The figures are based

on the assumption that a cubic foot of silage weighs on an average 40 lb.

TABLE 2 weight of silage per inch of depth

Diameter of Silo (ft.)	Layer I inch lb.	Layer 2 inches lb.	Layer 3 inches lb.
9	212	424	636
12	376	752	1128
I5	590	1180	1770
18	846	1692	2538
21	1155	2310	3465

Thus, a silo 15 ft. high from which 2 in. will be removed daily will last 90 days

daily will last 90 days.

An example will indicate the use of these tables. Supposing that it is intended to make sufficient grass silage to feed twenty milking cows at the rate of 30 lb. per head per day (this being a production ration for 1.5 gallons of milk if the silage is well made from young grass) for the winter feeding period of six months.

The total tonnage required will be about 50 tons and from Table 1 it is seen that this tonnage can be accommodated by using the following sizes:—

1. One silo, *2* tiers, 8 ft. high, 21 ft. diameter.

- **Two silos each 2 tiers, 8 ft. high, 15 ft. diameter.**
- **One silo, 4 tiers, 16 ft. high, 15 ft. diameter.**

For the 20 cows 600 lb. of silage will be needed per day. From Table 2 it can be seen that with the 21-feet diameter

silo this quantity would be obtained by removing a layer 1/2 in. in thickness each day— an impossible task in

1/2 in. in thickness each day—an impossible task in practice—or 1 in. every second day.

Two Small Silos preferable

By the use of the 15-feet diameter silo 1 in. per day or 2 in. every other day would give the required amount, but a further advantage attached to the use of the two smaller silos is the fact that all the grass for ensiling is not likely to be ready at the same time. It will be much more satisfactory, therefore, to fill a small silo in spring, seal and complete it, rather than half fill the larger silo, which would have to be opened later for completion.

Supposing the whole crop were ready for ensiling at the same time, the question arises as to which is preferable, two silos each 8 ft. high or one silo 16 ft. high. Ease of

working will generally be the deciding factor, but it can be seen from the discussion earlier in this chapter on the use of an over-silo that it will be much easier and quicker to fill the four tiers than two tiers.

Some idea of the yield per acre of the various crops is also necessary when considering the size of silo to be erected. Young spring or autumn grass will yield 3-4 tons per acre; grass and clover seeds mixtures, 5-7 tons; lucerne, 5-6 tons; arable silage crops, 8-12 tons; oats, 6-9 tons; maize, 15-25 tons; and beet tops, 8 tons.

Tower silos are made of wood, concrete, or steel, and the choice of material is largely one of cost plus the factor of personal preference. Wood has the advantage that it can be dismantled at any time and re-erected elsewhere, and hence is likely to be favoured by a tenant farmer. Concrete is, of course, permanent, whilst the sheet metal silos are

comparatively cheap, though care is necessary to prevent corrosion by the acids produced in the silage.

Tower Silos' Limited Use

Unless a farmer intends to make a large tonnage of silage annually from arable crops it is unlikely that a tower silo

annually from arable crops it is unlikely that a tower silo will be necessary: indeed, for young protein-rich foods such as grass this type of silo is not desirable. For bulky crops such as oats and tares, cut at a mature stage of growth, however, the tower silo equipped with chopper and blower is ideal. It is trouble free and produces a uniformly good type of silage with very little waste. The initial cost is naturally high, but those who wish to do so can purchase these silos by annual payments through the Lands Improvement Company.

Clamp or Pit Silage

Pit silage can be made without any capital expenditure other than that of the labour involved in making the pit. The terms clamp and pit are generally used synonymously, though the clamp really refers to a heap of silage made above ground level or in a shallow trench, whilst pit silage refers to the use of a pit several feet in depth. It will be obvious that if undue waste is to be avoided the use of a pit will necessitate greater attention to detail in making

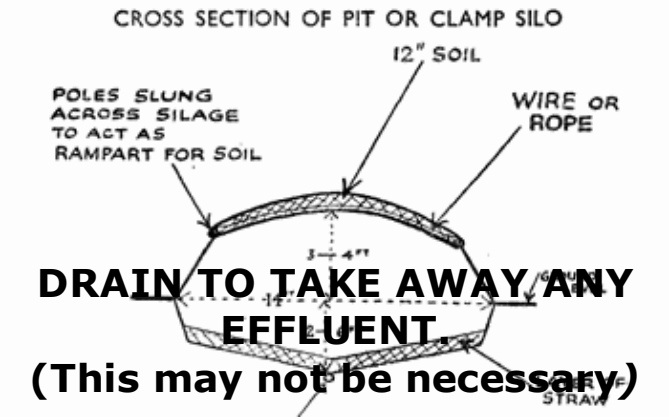
the silage.

Without such care the wastage on the top, sides, and along the bottom may amount to 25 per cent, of the crop and is proportional, of course, to the area of the exposed surfaces. Thus a small clamp will suffer a higher proportional waste than a large one, and for this reason the more orthodox type of container is strongly recommended for small-scale work. On the other hand, where a large acreage of a bulky crop such- as oats and tares is being ensiled, the clamp method has undoubted advantages and is the method advocated except when capital outlay need not be considered too closely and a tower silo can be installed.

Many farmers have made pit silage over a number of years, and are so highly skilled in the

method that the amount of waste incurred is negligible.

In making a pit silo the site must be chosen with care, for it must not be subject to water-logging in winter. If silage is to be made annually it will be advisable to make the pit in the stackyard where it is handy for use, and to concrete it out.



DRAIN TO TAKE AWAY ANY EFFLUENT.

(This may not be necessary)

Fourteen feet the best Width

The depth of the pit will vary from 2 to 6 ft., depending upon the type of the soil. In a free-draining soil with

plenty of depth it is possible to go down 6 ft., but in shallow soils on a heavy clay subsoil 2-3 ft. will usually be ample. The best width is 14 ft. irrespective of the depth, for this enables loads to be carted over the top. It is usual to slope the bottom slightly from the sides towards the

centre, running a tile drain along the middle to take away any surplus moisture. If preferred, the bottom can have a slight slope towards one end from which the surplus moisture can be taken away. The slight slope towards the bottom will allow good consolidation along the sides. The length of the pit will be determined by the amount of material it will normally hold. As a guide, when the pit is three feet deep one yard in length will be required for every acre of oats and tares. A more accurate method is to estimate the weight of the crop in tons per acre and use this formula:—

$$\text{Length of Pit (in feet)} = \frac{4A \times T}{D}$$

Where A = Number of acres to be ensiled

Where A = Number of acres to be ensiled.

T = Tonnage per acre of crop.

D = Depth of silage in feet (above and below ground).

and width of the pit is 14 ft.

If any difficulty is experienced in estimating the weight of green crop per acre the weight of the crop if made into hay should be estimated and this multiplied by three will give the weight of green crop. As a guide to the depth of silage above ground level it is usual to build it up as high as possible, which in practice does not generally exceed 6 ft.

In a pit or clamp the same principles of silage making apply, the main difference being that the bulk of the material is packed into a container below ground instead of above ground.

Stack Silage

To make a stack silo is by far the cheapest way of making silage, since no capital outlay is necessary. The method, therefore, has its greatest application when immediate action is necessary, as for instance, when a crop of hay is likely to be ruined by continued bad weather, or when a corn crop has been badly laid by storms and the straw is so twisted and broken that the binder is unlikely to tackle it. It is, of course, a very old method of silage making, and most districts have one or two farmers who have made this type of silage, at any rate in bad seasons.

The chief difficulty about stack silage is that of getting adequate consolidation of the material and as a result high temperatures are usually recorded. In addition, owing to free circulation of air round the outside of the stack, waste is inevitable. This can be minimised by careful treading of the outside, by paring off the loose material with a hay

knife, or by pulling it out to leave the side of the stack as firm and solid as possible. Even so, one or two inches of waste will be present, and this in the aggregate is appreciable.

Round stacks are preferable to square or oblong ones, for in the latter it is difficult to get adequate consolidation at the corners. The height of the stack should be not less than 6 ft., after settling has finished, which will mean building at times up to 12 ft. or even more.

The diameter of the stack is adjusted to the quantity of material to be ensiled, and here again as with other silos; one should not be too ambitious in starting on a very large base. Far better to go up higher, for then added consolidation will be obtained which will serve as a check on the rising temperature. The walls of the stack should

be almost vertical or very slightly drawn in towards the top. On no account must the stack widen towards the top for this will increase the amount of waste obtained. The

centre must be kept solid and slightly hearted, but when finishing off more generous hearting up can be allowed to give a good dome-shaped roof capable of shedding rain.

Importance of Weighting

As soon as the stack is completed it is essential to put plenty of weight on the top, for this will keep the temperature in the top layers within reasonable limits. Stones, sleepers or soil can be used for this purpose. Soil undoubtedly gives the best results for it will form an efficient air seal. To keep it in position a ring or rampart of sacks filled with soil or sand can be placed round the top edge of the silo. Additional compression can be obtained by suspending bags of stone or sleepers round the sides of the stack, by wires or ropes passing over the top.

Getting the soil in position is not an easy task, but if a hay elevator is available the work can be facilitated by tying bags between the slats of the elevator and tipping buckets of soil on to the bags. Sometimes it is an advantage to dig

of soil on to the bags. Sometimes it is an advantage to dig a circular pit about a foot deep before commencing to build up the stack. This will provide enough soil with which to cover the silo and at the same time will reduce the amount of uphill forking necessary.

Despite its drawbacks, stack silage is a useful method of conserving surplus fodder on the farm. The measure of success attained will depend upon the skill used in building the stack, and an appreciation of the limitations of the method will serve as a guide to the means that must be adopted to minimise the waste. It is not advocated as a suitable method for making high-protein silage from

young grass or leguminous crops, but rather as a means of preserving material that might otherwise be wasted.

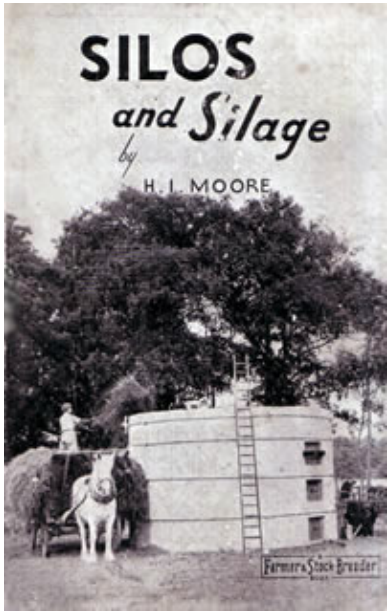
Levelling the site for a wire and paper silo

The stack silo. Note the straight sides

Thorough consolidation and good covering have reduced

waste to a minimum in this pit silage

The tractor can be used to help in excavating a pit silo



CHAPTER V

The Art of Making Silage

b y now it will be very evident that to make good silage requires patience, skill, and a complete understanding of the underlying principles of the process. It is perhaps unfortunate that the process appears so very simple to the uninitiated, for there seems little art in forking a green crop into a container and treading it down, covering it with soil, and then leaving it alone until ready for feeding. Most people who endeavour to make silage in this way find to their cost that there is more than meets the eye in this simple procedure, for the result of their efforts usually finds its way on to the dung heap. It is readily conceded that haymaking is an art, but in practice one finds that silage making requires an even greater measure of skill. The process is easy, but failure to attend to essential points can only result in poor quality material and much disappointment for the maker.

Choosing the Site

The silo should be so placed as to minimise labour when the silage is used. There is often the temptation in summer to erect it near to the crop and so save carting, for the green material is admittedly heavy. One is apt to argue that in winter when the rush of work is over, more time will be available for carting, but this false doctrine must be repressed. It is well to remember, when tempted by such considerations, that in winter roads may be snow-bound, that daylight hours are short, and that as silage will not keep in a fresh condition for more than a few days, regular and frequent visits to the silo are necessary. On most farms a site in the stackyard or near to the cowshed can be chosen, and if an overhead runway is used for removing dung it can also be used for taking in feeding stuffs generally, including silage.

Drainage for Effluent

When the silo is likely to be permanent a concrete base for it is advisable. This should be saucer-shaped and drained from the centre to a convenient point to which any effluent can be taken. The effluent should not pass directly into a ditch unless there is a good flow of water in it in summer time when the silage is likely to be made and seepage taking place. It should first pass through a simple rubble-filled sump or it may form gelatinous obstructions in the ditch or in drain pipes.

Whenever possible the silo should be so placed that it will allow carts to pass round it, and so enable the crop to be discharged at different points.

The site must be carefully levelled before erection is begun. For rigid-walled silos of concrete or wood this is necessary to obtain accurate fitting of the panels and avoid uneven strains on the walls. With the more

temporary structures of wire and paper this preliminary levelling is essential, or the silage will settle unevenly, the

wires will be twisted and bent, the paper lining torn, and much of the crop wasted (see Plate V).

There are many different types of cheap silo on the market and space forbids detailed instructions applicable to each type being given. If the maker's instructions are carefully followed little difficulty will be experienced in the erection or filling. It need hardly be emphasized that a spirit level will be necessary for this work, eye impressions invariably giving false levels.

A sump hole in the centre of the bed, filled with rubble, is a wise precaution for this will take any surplus moisture that collects in the bottom. It is a good plan to have at least a foot of straw in the bottom of any silo to act as an absorbent. Incidentally, when the straw has absorbed the

juices that are squeezed out it can be fed like the rest of the silage.

Filling the Silo

Only as much crop should be cut each day as can be ensiled in the day, except for two or three loads to stand overnight ready for the following morning. The crop must be carted fresh, and no advantage is gained by cutting a large acreage to be carted when convenient. Such a practice can, in fact, give rise to difficulties in filling, should the weather be hot and drying out take place in the field.

The amount to be cut each day will depend upon the diameter of the silo, for whatever this may be, a layer only 4 to 5 ft. in depth should be added at a time, unless the material is wet, when 3 ft. may be sufficient. More than

this amount at a time will delay heating, whilst insufficient material may cause undue heating.

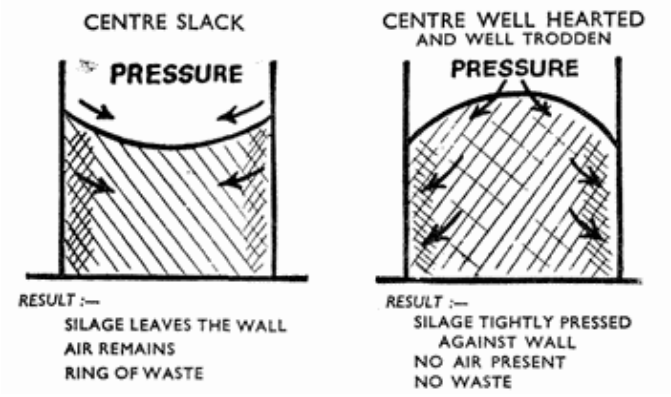
As the crop is filled into the silo each forkful must be well shaken up and spread evenly. Large forkfuls thrown in, and merely trampled down will mean the presence of air pockets and will cause mouldy patches. By discharging the

pockets and will cause mouldy patches. By discharging the loads at different points of the silo more even filling is obtained.

As filling proceeds the crop is trodden down tightly—and it is well to remember that there is a world of difference between treading and walking. To have a large number of men in the silo is of little avail if they are merely walking about instead of firmly pushing the crop into position. One might almost describe the procedure as one of coaxing the crop down with the foot.

Traditionally, the eye of the master is of considerable importance in the successful running of the farm, but experience shows that his foot is of equal value in making silage. He

value in making silage. He should make it his job to give the silage ten minutes treading the last thing at night and the first thing in the morning. To adopt this practice is frequently a revelation, and most certainly is very helpful in ensuring good results. Considerable attention must be given to the out-side edges of the silage, for there is always a tendency for the crop to cling to the wall of the silo, and if this is not counteracted as filling proceeds, air can be trapped in pockets and mouldy patches will result



If the silo has a paper lining it is a good plan to hold the paper with the fingers with a lifting effort, at the same time pushing downwards with the feet. Because it is important to watch the outside edge, however, does not mean that the centre can be neglected. Even treading

throughout is essential, but the centre must also be kept well "hearted up" and always about 2 ft. higher than the sides. This will promote outward pressure and keep the crop tightly pressed against the wall of the silo, whereas if the centre is allowed to get slack the pressure will naturally be in the opposite direction, and will tend to pull the material away from the silo wall. Thus air will be trapped between wall and crop and a ring of mouldy silage will result.

There is no virtue in maintaining a full centre if this is not of well trodden material. Many may think the centre is well "hearted up" when it merely consists of a few

forkfuls of stuff thrown loosely into position (see diagram).

Adding the Molasses

The molasses solution should be sprinkled on every 6-in. layer. To do this a watering can is all that is required except for big tonnages. Then it is apt to become somewhat tedious and may be scamped, and under such circumstances a small semi-rotary pump is a sound investment. This type of pump is cheap, trouble free and has a long life.

If a watering can is used the amounts added to the crop can be checked quite easily, but if a pump is used this will be connected to a barrel containing the solution, and the barrel must first be calibrated. This, however, presents no difficulty, for by putting a series of nails or white paint marks on the inside of the barrel, indicating the level of each gallon, a check can be maintained on the amount of

solution used.

Molasses mixes quite well with cold water, but if warm water is available the process is speeded up. So far as strength of solution goes the following amounts of molasses are required:—

Young grass .. 20 lb. (or 1.5 gal.) per ton of crop

Clover, Lucerne

Sainfoin .. 30 lb. (or 2.25 gals.)

For young grass or clover, which is generally moist when ensiled, the molasses should be dissolved in an equal volume of water. If, however, the crop dries out before it is put into the silo the molasses should be mixed with twice its volume of water. Very occasionally, if the crop is really dry it may be desirable to add more water than suggested above, but this must be left to the judgment of the man on the spot.

Except for young grass or other protein-rich foods that are low in fermentable carbohydrate, the addition of molasses is not necessary. Its use in non-essential cases merely adds to the expense of the process and in war time is wasteful.

Rate of Filling

Each four- or five-foot layer of material added to the silo must attain a temperature in the region of go degrees Fahrenheit before more is added. This is essential in order to obtain a uniform product throughout the silo. Under normal summer conditions, when the crop does not hold any surface moisture, filling may take place each day. On the other hand, if the crop is very immature or the weather wet, the crop will pack down tightly and may not attain the desired temperature overnight. When this occurs an interval should be allowed for the necessary

fermentation to take place. No advantage is gained by

rushing the process: in fact, harm can easily result.

The only guide as to when to fill, or when to wait is that of temperature. If this is in the region of 90 degrees Fahrenheit then one can carry on, but if the temperature is too low one must wait. Frequently it is an advantage to erect two silos side by side, for these can then be added to on alternate days, thereby allowing each day's quota time to heat up before more is added. Normally, the interval between additions should not exceed two to three days or mould will develop on the surface.

If, owing to shortage of material, filling has to be temporarily suspended, the layer should be covered with sacks and then well weighted down (see Plate IV), this being necessary to prevent overheating in the top layers of the crop. A stack sheet should always be slipped over the top of the silo to keep out rain.

When filling commences again it will be necessary to remove any mouldy material from the top. Even where

remove any mouldy material from the top. Even where great care is taken, and no mould can be seen, it frequently happens that when the silo is opened a narrow band of mould is found along the line between the different fillings.

Topping Up

Towards the top of the silo a good dome-shaped roof should be made, to assist in shedding the water, and when filling is completed the silo must be sealed immediately. By far the best way of doing this is to cover it over with sacks or treated paper to keep the crop clean and then add a good layer of soil rammed into position. American research workers have shown that a weight of 15 lb. per

sq. ft. is desirable to reduce wastage to a minimum.

It is vitally important to note how far the silage settles after sealing in this way. Should it settle below the upper edge of the silo it must not be left like this over winter. Obviously, were this to happen the silo would act as a

gutter for rain, which would seep down inside the silo and cause a good deal of waste as shown in Plate V.

Rubbish as Filling

With most types of wooden or concrete silo this can be avoided by dismantling the top tier. With many home-made silos or those of the wire and paper type this is not always possible. Here the paper lining should be doubled back towards the centre of the silo to deflect rain and then the soil can be placed in position. An alternative, of course, is to fill the silo to the top with waste grass or

other material, the loss of which is not serious.

For several days after soiling down it is advisable to tread the top thoroughly, not only to help in consolidating the crop, but also to fill in any cracks that may have formed in the seal. If turf is available, a layer placed grass side down on top of the sacks is excellent and, with a little care in cutting the turf to shape, a perfect seal can be obtained.

Three inches of soil should be rammed on top of this.

To keep the soil in position on a stack a ring of sacks filled with soil should be placed round the outer rim to act as a rampart.

When the silage has finally settled and the seal has been«made perfect, the silo should be thatched and made water-proof. A soil seal alone is not sufficient, for rain is sure to penetrate and cause spoilage. Thatching can be

avoided by erecting the silo under a barn, or when a wooden or concrete silo is built a permanent roof can be made.

Soiling down is admittedly a tedious job, but it must be done if waste is to be avoided. The heavy task of getting the soil into position can be lightened if an elevator is available. Sacks can be tied on to the elevator slats and buckets of soil emptied on to the sacks will then be carried to the top of the silo. When a layer of wet waste

grass is used for topping up it must be well trodden down. It does not, however, give the same pressure as a good covering of soil and, in consequence, the top layers of silage are apt to be over-heated. There is no short cut to efficient sealing.

How Long will Silage Keep?

Once "airtight" and "watertight" a silo can be left unopened for several years with the confident knowledge that the silage will keep in perfect condition. Sometimes one hears the argument put forward that to have a little bit of waste on top is cheaper than the labour involved in soiling down and thatching. Unfortunately, in these instances, it generally happens that the "little bit of waste" develops into several tons before the silo is opened.

Special precautions are necessary with a tower silo to ensure a uniform product. For such a silo the crop is

always chaffed and blown to the top through a metal tube. Inside the silo a man distributes the material to all parts of the silo, and, as each layer is spread, it should be evenly trampled.

In high silos of this type there is a very considerable

pressure on the lower layers from the superimposed weight of material. It is not essential, therefore, to trample in this region so heavily, and the man who is spreading the chaffed crop can tread sufficiently at the same time. When the half-way line is passed, however, it becomes necessary to have a second man treading.

Avoiding Excessive Compression

To counteract the tendency to excessive compression towards the bottom of the silo, not only should the treading be light, but the crop should be more mature or drier. If, for instance, the crop is allowed to wilt in the field for half a day before carting, a good deal of moisture will be evaporated.

will be evaporated.

With the tower silo, however, as with other types, the criterion as to when or when not to fill is temperature.

Each 4- or 5-ft. layer of crop should attain 90 degrees Fahrenheit as an optimum temperature before more crop is added. In one instance I investigated, a 50o-ton silo contained nearly 100 tons of sour, rancid silage at the bottom. This was due to excessive pressure preventing the desired degree of heating from developing, thereby promoting a butyric fermentation and not the desirable lactic fermentation.

The trouble was remedied very simply by merely filling the bottom of the silo with a crop cut at a fairly mature stage of growth and allowing it to heat up sufficiently before continuing to fill.

Towards the top of the silo a more succulent condition in the crop ensiled is permissible, for this, by reason of its weight, will help consolidation and will pack tightly.

Moreover, since adequate consolidation at the top is always difficult to attain, the use of a very dry crop in this region would promote overheating, whereas by using a much moister crop this is minimised. The last ten or twenty loads can be of wet green grass if this is available, but good treading will still be necessary.

For another reason rapid filling is to be avoided. Unless the silage has time to heat and settle gradually the effective capacity of the silo cannot be obtained, for settling will take place over several weeks.

It is difficult to seal a tower silo, for although a layer of soil a foot in thickness is highly desirable, giving compression and an efficient air seal, it is no easy task getting it to the top of the tower. It is, therefore, more feasible to blow some waste grass or other material on top and then discard this when the silo is opened. With careful work at the top the amount to be discarded need only be 3 to 6 in., but with careless work it can be as

only be 3 to 6 in., but with careless work it can be as much as 3 ft.

In a pit or clamp the same principles apply as with any other type of silo, for making good silage. Even filling and good compression are essential, and the requisite amount of heating must take place.

Filling a Pit Silo

The loads of green crop are tipped up at the side and spread evenly in the excavation. When ground level is reached the loaded carts are taken over the top to aid compression. Unless care is taken in making pit silage excessive pressure in the lower layers may be obtained, and this will result in sour, unpalatable silage. The danger can be easily avoided, however, by the same means as suggested for the tower silo, namely, by allowing the crop

to wilt in the field or by using a more mature crop for filling this part of the silo.

It is always a good plan with a pit silo to cover the bottom with a good layer of straw, for should the pressure result in an excessive loss of plant juices this will be absorbed and a better product obtained.

Having put in 3 ft. of crop, filling should be suspended until this material has heated sufficiently. As the heap becomes higher a trace horse will be required to assist in hauling up the loads. In the intervals between loads the horse can be used for treading the sides. In practice it is difficult to build the heap much more than 7 ft. above ground level, and this necessitates extending the material beyond the ends of the pit in order to provide a good run up for the horses and carts. The sides of the silage should slope slightly inwards towards the top to ensure good compression on settling.

Trim Ends

When carting is finished the sloping ends should be

trimmed off and thrown on top of the heap. All workers should assist in giving a final treading to the silage before it is sealed.

The silo may be completely covered with a good layer of soil, after the style of a mangold pit, but if it is, care must be taken to tread the heap each day so that the silage is never allowed to settle and leave the soil arched over it, bridge fashion, with an air cavity between. This would naturally result in a good deal of waste.

By far the best method of covering a pit silo is that advocated by Mr. Arthur Amos when at the School of

Agriculture , Cambridge , some years ago. The method consists of slinging large poles, 4 to 6 in. in diameter, on each side of the heap by means of wires or ropes passing over the top. The poles form a rampart to hold the soil in position (see page 65). Thus the pressure of the soil is applied to the top of the material, and as it settles the soil can settle with it. No danger of "bridging" exists, and the

weight of soil prevents the top layers of crops from overheating. A small amount of waste must be expected where the sides are open to the air, but this need not be excessive.

When the silage is ready for use the silo is opened at one end and slices are cut—bread fashion— sufficient for one or two days' supply, gradually working towards the other end.

Where Pits May be Advisable

The pit silo has much to commend it, especially where large tonnages of bulky crops are concerned. Though orthodox containers are preferable for small quantities of short grass, any farmer who contemplates making several hundred tons of grass silage should consider using pit silos. For this kind of short material, which packs well, smaller pits than are commonly used for arable crops are to be preferred. As a rule at least 1 ft. thickness of grass should be added per day, and the addition of molasses is

advisable.

With care, and attention to the important points outlined in this chapter, any farmer should succeed in making good silage at the first attempt. Waste means failure to observe some vital factor, and where it occurs the cause should be sought so that the trouble may be avoided in future.

Causes of Waste

Side Waste

By far the commonest fault in portable silos is the presence of a ring of wet, evil-smelling material round the wall of the silo. It may vary in thickness from a few inches to a foot or more, and in bad cases will extend from top to bottom of the silo. The waste generally has both the smell and appearance of dung, and is greasy to the touch. It may be brought about in two ways:

- **If the silage is allowed to settle down below**

- **If the silage is allowed to settle down below the top rim of the silo and remains in this position over winter, rain water may cause the damage by seeping down the sides of the silo as already indicated (see Plate V). The remedy has already been indicated, and lies in removing the top tier before finally topping up and thatching.**
- **A more common cause of the trouble is insufficient treading of the centre of the silo and failure to keep it well hearted up with well-trodden material, causing the silage to leave the wall of the silo. As soon as air has access to the crop moulds will develop; these restrict the acidity of the silage, and as a result, undesirable putrefying bacteria find conditions for their liking and commence their destructive work. Should this trouble be experienced greater care must be exercised in future in treading the material evenly, in keeping the centre really hearted up**

centre really hearted up.

Top Waste

If more than an inch of waste has to be discarded

from the top of the silo the sealing has been faulty. To avoid this the top of the silo must get extra trampling; it must be soiled down immediately after the silo is filled, and the seal must be maintained by filling all cracks that appear. Unless a roof to the silo is provided it must be thatched to keep out rain.

Dark Coloured Silage

Good silage is pale yellowish-brown in colour, and has a pleasantly acid smell aptly described by someone as that of cheese and pickles. If the colour is dark brown or black excessive heating has taken place; indeed, the degree of heating can be judged by the darkness of the silage. The cause of

the trouble may be too slow filling, too dry a crop, or insufficient treading.

To avoid this the crop should be cut at a less mature stage, carted and ensiled as soon as possible, and be trodden more firmly. Should the crop be long and coarse steps should be taken to chop it. If it is very dry the addition of water will be an advantage.

Bottom Waste

One frequently finds at the bottom of a silo, particularly in the pit or tower, evil-smelling and very wet material. Here the compression has been excessive or the crop too wet or immature. It can also result from an accumulation of liquid in the bottom of a silo when no drain or sump is provided. The remedy is obvious and has already been discussed at some length (p. 71).

Mouldy Patches

These are due to air pockets, already mentioned; and to avoid this trouble each forkful of material must be well shaken up in the silo, while treading must be even and regular.

Evil-Smelling Silage

A pungent, sour, or rancid smell denotes too low a temperature and the presence of undesirable bacteria. Very often the colour of this silage will be olive green. The cause of the trouble is generally the use of very succulent, immature crops, or failure to allow a crop with a high water content—such as kale or maize to heat up sufficiently. To prevent this the silo should be filled more slowly, the material trodden lightly, and if the crop is wet or very succulent it should be mixed with some chaff or chopped oat straw.

In recent years a large number of silos have contained waste. It is, of course, to be expected that

certain "teething troubles" should be experienced in the first attempts with a new process, and that these should be eliminated as experience is gained. A "perfect" silo should contain no waste other than a very small layer at the top where the sealing material meets the silage.

Results from 400 Silos

During the seasons 1938-1941 the author inspected over four hundred silos of all types and a critical analysis of the results given in Table 3 is very instructive.

TABLE 3 waste in silos—seasons 1938-1941

Type of Silo	Number inspected	Number with waste	Number with waste	Number of 'perfect' silos

		less than 5%	**over 25%**	
Wire or Paling:				
paper lining	150	65	25	10
Portable : wood	72	58	4	14
concrete	30	25	3	6
Tower	6	5	0	4
Home-made	76	31	15	4
Converted buildings	38	13	10	3
Stack	17	4	5	1
Pit	11	7	2	1
Total	**400**	**208**	**64**	**43**

Only one in fifteen of the wire and paper types could be

Only one in fifteen of the wire and paper types could be regarded as attaining the standard that no waste was present that could have been avoided. This is not to be regarded as a reflection on the efficiency of these silos, but indicates that greater care is necessary in the erection and filling of them, if waste is to be kept within reasonable limits. This is confirmed by the lower percentage of perfect silos obtained with home-made containers, which not only involve the difficulties attaching to temporary structures, but also those concerned with constructing the silo itself.

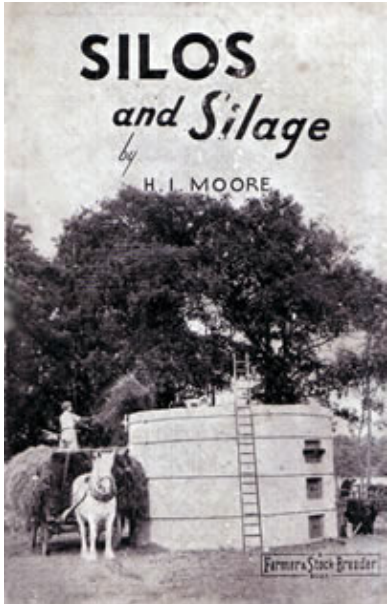
Need for Sound Plans

Waste in converted buildings was also high, and was due in most instances to over-ambitious plans in the first place. For instance, a barn 15 ft. by 30 ft. is much better converted by a simple partition into two containers each 15 ft. square, to be filled one at a time or on alternate days. Many find that, having started with a big base, they have not sufficient material to get the depth required to

have not sufficient material to get the depth required to control the temperature at the desired level of 90 degrees Fahrenheit.

Of the silos inspected, 381, or 95 per cent., had top waste in varying amounts; 370, or 92 per cent., showed some waste at the base; and 253, or 63 per cent., had some side waste. Over 25 per cent, of the silos had exceeded the limit in temperature for the production of high-class silage, and 22 per cent, contained mouldy places due to uneven filling.

This waste can and must be avoided. If the previous table does no more than indicate the need for care in filling silos of all types it will have served its purpose.

CHAPTER VI

Feeding of Silage to Stock

silage is a succulent food comparable in feeding value with the crops from which it is made. The quality, however, varies greatly according to how and when it is made, and the type and condition of the material of which it is composed.

For practical purposes silage can be divided into three main groups: Group I, High-quality silage; Group II, Intermediate-quality silage; and Group III, Low-quality silage. Silage that falls within the first group can be regarded as an adequate substitute for concentrated cakes and meals; that within the second group as a roughage somewhat richer in feeding value than average meadow hay; and that in the third group a roughage that will replace part of the hay, straw or roots in the animal's

ration.

Protein the Guide

In giving this broad classification the terms "high" and "low" refer to the protein content of the silage and not to the general characteristics of the material. For instance, it is not intended to convey by the term "low quality" silage that this is bad silage, but merely that it is low in its protein content compared with the carbohydrate present.

The group to which any particular silage belongs is easily determined from a knowledge of the crop and its condition at the time of ensiling, and from the appearance of the finished product as it is taken from the silo. Cake substitute silage, for instance *(i.e.,* Group I), can only be produced from young grass, clover, lucerne, or sainfoin when the crop is cut at the right time and ensiled in the right way.

Occasionally one finds an oat-and-tare silage which, being

cut at an early stage of growth, can be classified under the heading, but this is not by any means the general rule. By no act of magic can old stemmy grass be converted into high-quality silage, and crops that are low in protein can only produce low-quality silage *(i.e.,* Group III), even though they are ensiled under ideal conditions.

Colour and Smell

Cutting the right crop at the right time, however, does not ensure a Group I silage, and having started on the right lines success will be dependent upon the manner in which the crop is ensiled. Success achieved in the process of converting the crop into silage can be judged by the colour and smell of the product. High-quality silage will have a golden yellow or light yellow-brown colour and. the characteristic acid smell already described. Silages that come under Group I will contain 15 per cent, or more of crude protein in the dry matter.

Good quality intermediate silage *(i.e.,* Group II) will have

the same colour and smell noted in Group I, but, being made from grass cut at a more mature stage, or from cereal-legume mixtures that are fairly mature, the protein content will be lower, and the group contains from 12 to 15 per cent, of crude protein in the dry matter.

Under Group III, Low-quality Silage, will come those silages which, though well made, are low in protein because the crop is low in protein. Maize must, therefore, be included in this group, together with grass cut when at the seeding stage, pea haulms, and so on. The protein content of silage in this group is less than 12 per cent, of the dry matter.

Thus, we can roughly classify any type of silage into one or other of the three groups mentioned, and for ease of reference the groupings are given in the following table. It

must be realised, of course, that this grouping is on very broad lines, and that it is possible for any particular silage, by good management, or by bad, during the

ensiling process, to have a composition which entitles it to a place in a higher or only a lower group.

TABLE 4 classification of silage

group I	group II	group III
Cake Substitute *(Over* 15% *Crude Protein)*	*Hay and Some Cake Substitute* (12-15% *Crude Protein)*	*Hay, Roots or Straw Substitute* *(Less than 12% Crude Protein)*
Young Grass — no grasses in flower	Grasses at flowering stage.	Grasses at Seeding stage.
Clover, Lucerne , or Sainfoin in bud stage.	Late Autumn Grass Clover passed full flower.	Stemmy, mature clover
	Cereal-Legume Crops cut when cereal is	Maize, Pea haulms & pods, Potatoes,

	cut when cereal is "milky." Sugar Beet Tops. Marrow Stem Kale. Mangold & Turnip Tops.	pods. Potatoes.

Period of Use

Once silage has been introduced into the ration its use should be continued until such time as the stock goes out

to grass. To stop feeding it is a bad practice, particularly with dairy cows, for it will inevitably cause a drop in milk yield that it is extremely difficult, if not impossible to regain. Thus, the quantity produced should be carefully estimated and the allowance so arranged that it may be included in the ration from the outset until there is sufficient spring growth to justify turning the stock out.

It is always a wise insurance to allow a good margin, for spring grass is apt to be late in growth and very limited in quantity, as most stock-feeders know to their cost. Having determined the total amount of silage available at the start of the winter feeding period, a simple division by the number of head of stock to which it is being fed, and again by the quantity to be fed each day, one arrives at the number of days that it will last. One can then plan when to start feeding in the sure knowledge that the supply will last out.

Insurance against Drought

On many farms, another consideration that will to some extent determine the time when silage can be introduced into the ration is the fact that kale, turnips, swedes, or other forage crops are likely to be available. When any crop is fed "fresh" this should be done before commencing with the silage, for the latter will keep and the former will not. It is also a wise precaution wherever possible to keep some silage in reserve for summer drought.

When the pastures are burnt and bare, and milk yields commence to fall at an alarming rate, there are few foods that can be compared with silage to maintain the flow of milk. If early spring grass has been made into silage this can always be used in a summer emergency, but in practice such a method of "robbing Peter to pay Paul" is not advocated, for the chances are that all the new season silage will be urgently needed the following winter.

When the silo is opened the silage can be classified roughly into the groupings already outlined, and an approximate idea of its feeding value thereby obtained. Many farmers, however, will require more accurate information. As silage is a succulent food the ration will naturally be affected by the amount of water it contains, for, obviously, if the sample contains 70 per cent, of water, more silage will have to be fed than if it contains 60 per cent, of water. Thus, the dry matter of the silage should be determined.

Testing for Dry Matter

This can be done in a very simple way. Ten pounds of silage taken fresh from the silo should be placed in a biscuit tin and dried slowly—to prevent charring—in the

kitchen oven. When no further moisture remains the dry silage should be weighed again. The figure so obtained, multiplied by ten, will give the percentage of dry matter. An average example of good silage will usually contain about 25 per cent, of dry matter.

Dry matter content of the silage from any one silo is not constant. Usually, it is slightly higher when the silage is taken from the top and lower when nearing the bottom. Thus, if 40 lb. of silage per head are fed when the silo is first opened, it does not follow that 40 lb. of silage will have the same feeding value when taken from lower layers.

In one instance three samples of grass silage were taken from the same silo, one from the top, one from the middle and one from near the bottom. The dry matter contents were 30, 24, and 20 respectively, and, hence, to have fed a uniform quantity would have been far from accurate.

To Ascertain Protein Content

Another factor of importance in determining the feeding value of silage is, of course, the protein content. Whilst dry matter can be determined simply at home, the accurate determination of the protein content must be left to the analytical chemist. This will gladly be carried out by the University or Agricultural College of the County, and farmers who wish to avail themselves of this service should get into touch with the authority concerned.

If the silage is analysed in this way for two or three seasons an idea will be obtained as to how different materials and different technique affect the quality of the product obtained, and from the experience so gained the

product obtained, and from the experience so gained the approximate value of any silage—sufficient for all practical purposes—can be obtained, and further sampling will be unnecessary.

Maintenance and Production

An animal's ration can be divided into two portions, one being required for maintenance— called *the maintenance ration,* and the other for production, and this is called *the production ration.* The maintenance portion of the ration is required to keep the animal going, whilst the addition of the production ration will enable it to produce milk or meat.

Foods that are generally used for the *maintenance* diet are home-grown, such as hay, straw, roots and forage crops. Those that are used for *production* purposes may be concentrated cakes or meals, or home-grown pulse crops, such as peas or beans, which are rich in protein.

Silage can also be used for maintenance or production requirements depending upon its quality, and, as already indicated, Group I silage can be considered as suitable for production purposes, Group III for maintenance only, and Group II for maintenance and perhaps part of the production also.

It is not within the scope of this book to enter into the complications of animal rationing, but the following table will serve as a guide to the value of the different silages that are likely to be produced for both maintenance and production.

TABLE 5 the use of silage in production and maintenance rations

Maintenance Rations for each 2 cwt. live-weight	***Production Rations for each gallon of milk or pound of flesh***

groups II and III silage	group I silage
Grass . . 9-11 lb	Grass . . . 20 lb.
Oat and Tare . 11 lb	Clover . . . 25 lb.
Maize . . . 12.5 lb	Lucerne or Sainfoin 28 lb
Sugar Beet Tops . 14.5 lb	
Pea Haulms . . 15 lb.	
Mangold Tops . 17 lb.	

Foods other than Silage

Meadow Hay . 4.5 lb	Dairy Cake . . 3.25 lb
Oat Straw . . 5.5 lb	Pea or Bean Meal 3.25 lb.
	Seeds Hay . . 10 lb

Thus, a dairy cow weighing 10 cwt. and producing 2 gal.

of milk could receive 33 lb. of oat and tare silage and 8.5 lb. of meadow hay for maintenance, and 40 lb. of first quality grass silage for the production of the 2 gal. of milk.

How to Feed

Silage should always be introduced gradually into the ration. Once stock acquire a taste for it they will consume large quantities with avidity, and a cow commencing with, say, 10 lb. daily will soon work up to 60 lb. or even more. If the silage is good little difficulty will be experienced in getting them to take it, although one must always anticipate difficulty with certain individuals.

An instance comes to mind, in which Shorthorn and Highland cattle were fed in the same yard with the same good silage. The Shorthorns took to it with relish, the Highlanders refused it consistently.

The requisite quantity of silage should be removed from the silo daily or, at most, every other day, preferably by

taking it layer by layer, commencing at the top of the silo. To avoid waste in feeding, occasional check weighings should be taken of a cart load, barrow load, or even a sheetful.

Doubts Removed

There need be no fear that silage will cause taints in milk if fed properly. It should always be fed *after* milking, so that the smell does not linger in the cowshed and be absorbed by the milk after it leaves the cow. It is also

essential that any uneaten material should be cleaned from the trough before it goes rancid.

Scepticism is sometimes expressed that the acidity of this feed is harmful to stock or may even cause sterility. There is no foundation for such beliefs. The acid has no harmful effect whatever, being largely, as we have seen, lactic acid, which is present in sour milk, and it is, in fact, used up by the animal as a source of energy.

In addition to the improved colour and production of milk obtained by feeding silage, a general tonic effect will be noted in all classes of stock, and this is very evident in the sheen and healthiness of their coats. Many stock owners have also observed that following a winter when silage has formed a large part of the cows' rations, they return earlier to the bull than when fed on rations not including silage.

Silage alone up to Three Gallons

In general, high quality silage should be reserved for the production ration of milk cows and will be fed in conjunction with such foods as hay, straw, roots or other forage crops that will provide the maintenance ration. When such foods are available plus good silage there is no need for cakes and meals except when a cow is giving more than 3 gal. of milk daily. With these higher yielding cows the problem of keeping the bulk of the ration within the capacity of the cow necessitates the use of more

concentrated food for the fourth or fifth gallon.

At the Jealotts Hill Experiment Station up to 70 lb. of grass silage has been fed throughout the winter to a group of cows that milked well and normally on the ration. An even more extreme instance has been recorded at the Rowett Research Institutes' Duthie Experimental Farm, where a

cow ate 152 lb. of high quality silage per day, and maintained an average yield of 5 gallons of milk daily for two months with no other food.

Few farmers are likely to have sufficient good silage to feed it in this way, nor for that matter is it desirable to strive for this goal on farms where hay, straw, and root crops are grown in the normal course of farm routine. The example is given, however, to show the possibilities of silage and will convey some impression of its high feeding value when well made.

Quantities to Feed to various Classes of Stock

No hard and fast rules can be laid down as to the amounts to be fed to the various classes of stock, and farmers using silage for the first time are urged in their own interests to seek expert help and guidance.

Response of milk cows to silage is very marked, and as it is important to maintain the milk supply, cows in milk should have first call on the silage available and should receive the best that has been made. All dairy farmers experience the difficulty of maintaining yields in March and April, when the cows begin to tire of winter rations and the spring grass is still insufficient to justify turning out.

Those who have silage, however, will find that it bridges this gap, and that by its use in the hungry months of the year milk yields can be maintained. By utilising silage to the fullest extent in the feeding of all cows giving up to 3 gal. of milk, the short supply of cakes and meals now available can be reserved for the high-yielding cows. Six pounds of good molassed grass silage will replace one

pounds of good molassed grass silage will replace one pound of balanced dairy ration.

Intermediate Quality for Fattening

Silage will be found a valuable food for fattening cattle, and high-quality silage will replace the cake normally fed. To feed a large quantity of this type of silage, however, may be wasteful by providing more protein than the animal requires. Thus the intermediate quality silage will be more useful to replace hay, straw or roots for fattening cattle.

As a general rule dairy and fattening stock will receive up to 35 to 45 lb. per head per day, along with other foods.

Store cattle will winter well on a ration of 20 to 30 Ib. of silage (Group II or III) in addition to hay, and calves should have it introduced into the ration at an early age to replace part of the roots and meal.

It is not generally realised how useful silage is for ewes in lamb and for fattening wethers. It should be introduced to them by feeding about 1 lb. per head per day of the Group II or III type, and this can be increased gradually to 5 or 6 lb. per head per day. With in-lamb ewes care must be taken not to feed any doubtful silage. It can be thrown out on to grass or given in racks.

Silage is much too bulky a feed to play any considerable part in the feeding of pigs or horses, as both classes of stock have comparatively small digestive organs. Pigs can receive up to 2 lb. daily as a tonic and supplier of vitamins, lack of which is often responsible for many pigs failing to thrive. Empty sows can receive as much as 15 lb. and this will replace 3 lb. of pig meal. The silage fed to pigs will largely be of the by-product type.

Although silage is seldom fed to horses, brood mares will

benefit from a few pounds daily of molassed grass silage during the winter, whilst up to 25 lb. per day can be fed to

during the winter, whilst up to 25 lb. per day can be fed to working horses without fear of ill effects.

Silage for Poultry

At a time when concentrated foods are in very limited quantity the introduction of silage into poultry rations deserves attention. Little information is available as to its use in this country, but American and Continental experience is fairly extensive and has shown that when the silage is chopped and mixed with meal to a crumb-like consistency, up to 2 oz. per bird per day can be consumed, and the quantity of laying meal required reduced by as much as 25 per cent. Usually, when small quantities of silage for poultry are required it can best be made in barrels holding about 3 cwt. Lawn clippings are ideal for this purpose.

Recent work in Kansas has shown that molassed silage was readily eaten by the birds and produced sturdy yellow-shanked chicks, but that 30 per cent. of the eggs were "grass-eggs with olive-yolks."

were "grass-eggs with olive-yolks."

In contrast to this, however, at the University of Tennessee , hens fed on legume silage consumed 4 oz. per day; egg production went up by 50 per cent., and no "grass eggs "were produced. Moreover, cockerels fed on the silage gave 20 per cent, more live weight increase than those receiving no silage.

Thus it would appear that silage made from young protein-rich crops may have a decided value in ekeing out meagre supplies of concentrated foods, and poultry keepers would do well to investigate its possibilities for themselves.

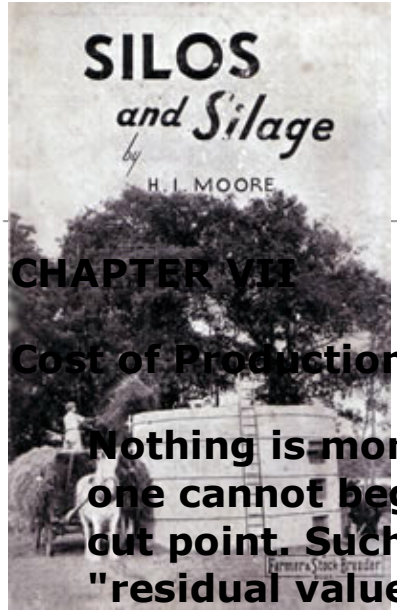
Amounts of silage included in any rations for farm stock will vary considerably, depending upon the total quantity available and the nature of the other foods that are being used. Little value, therefore, can attach to specific rations, but in order to serve as a general guide in the use of silage the following rations are given and can be used with

confidence :—

TABLE 6 specimen silage rations *(Incorporating only Home-Grown Foods)*

	Dairy Cows* 10 *cwt. live-weight						
Foods available	***Maintenance plus 1gallon***			***Maintenance plus 2 gallons***			***Maintenance plus 3 gallons***
Alternative Mixtures	*1*	*2*	*3*	*1*	2	3	*1*
High Quality Grass Silage.	20	20	20	56	40	40	56
Intermediate Grass Silage	45				23		

Grass Silage:							
Cereal-Legume or Maize Silage		28				28	
Hay		10	20		10	10	20
Oats (Crushed)				6			

CHAPTER VII

Cost of Production of Silage

Nothing is more difficult to cost than a farm crop, because one cannot begin at a fixed point and end at another clear-cut point. Such arbitrary costs as "overhead charges" and "residual values" should, strictly speaking, be taken into account, but in presenting the cost of production of the different types of silage in this chapter no attempt has been made to include all possible items, nor are the figures given the average of many diverse farms and conditions.

In each instance good average farms have been selected

where silage has been made for a number of years, where the technique is, therefore, sound, and where by keeping careful records it has been possible to obtain a broad impression as to costs of production.

Value of Grass

In estimating the cost of production of grass silage the first difficulty that arises is what to charge for the grass. It is seldom that the grass is grown specifically for silage. More usually a permanent grass field is selected and either top dressed with nitrogen in spring to produce an early cut, or the aftermath is taken in autumn. In the former event the cost of the grass would include some item for rent and overhead charges, and the cost of the fertiliser and its distribution.

One may ask, however, should one debit the grass with the full cost of the fertiliser or only allocate a proportion, on the assumption that all the nitrogen will not be used

and some will remain to stimulate more grass? When aftermath is used, what proportion of the rent is chargeable to the grass?

Silo Depreciation

The following cost of production does not include any item for the grass itself. In estimating the amount to be allowed for the item of depreciation of the silo this has been based on the purely arbitrary assumption that a portable wooden silo has a life of ten years and a wire silo three years, the latter requiring the lining to be replaced each year. In practice, both types of silo should have a much longer period of use with reasonable care.

In many districts large quantities of grass are now available from aerodromes, public parks and housing estates, and this can be obtained at a nominal charge, or very often it is free for the carting; hence the following costs of producing grass silage will be of use to farmers

who wish to have some idea of the probable cost of converting such grass into silage:—

Cost of Making Grass Silage per ton

	s.	d.
Cutting and collecting crop	5	6
Erecting, filling and sealing silo	2	4
Molasses	2	6
Depreciation on silo	2	3
	12/7	per ton

Total acreage studied, 120.

Average yield of Silage per acre per cut, 2.7 tons.

Man labour, 1/- per hour.

Horse labour, 6d. per hour.

Maize Silage

With maize silage the average cost per acre does not vary greatly from year to year, but the cost per ton of silage is, of course, dependent upon the yield, and this can vary widely with the season. On fertile land in a season of good growing weather, with no prolonged dry periods, a green crop of 30 tons per acre may be obtained. In a dry season, however, especially if the plant gets a poor start in the early stages of growth, no more than 12 tons may be obtained.

Cost of Production of Maize Silage

***Growing Costs per acr* e**	**£**	**s.**	**d.**
Rent	2	0	0
Man Labour		19	0
Horse Labour	1	3	2

Seed ...	2	0	0
Fertiliser	1	17	0
Silo-Filling Costs	2	7	3
Depreciation on Silo		2	0
Miscellaneous		5	6
Total cost per acre	**10**	**13**	**11**

Average yield per acre, 20 tons.

Average cost per ton silage, 10s. 8d.

Total acreage studied, 27.

Man labour, 1/- per hour.

Horse labour, 6d. per hour

Cereal-Legume Silage

Here again the yield of crop is very variable, depending

upon soil and weather conditions. Many crops do not average much more than 6 or 7 tons per acre, yet one frequently hears of up to 20 tons per acre being obtained. On one occasion on a Yorkshire farm the author inspected a crop of rye, beans, and tares 8 ft. in height, where the average yield per acre was over 20 tons, and the crop so thick that the utmost difficulty was experienced in getting the mowing machine through it.

In the northern part of the country this is very unusual, but in the southern and eastern counties good average crops are obtained. The cost of production will also vary with the method of growing.

Labour can be reduced, for instance, by drilling the seed into the stubble instead of the more usual sequence of operations of ploughing, harrowing, and drilling:—

Cost *of Production of Cereal-Legume Silage*

Growing Cost per acre	***£***	***s.***	***d.***

Rent	1	10	0
Man labour		11	6
Horse labour		5	8
Tractor labour		15	4
Seed	1	17	6
Fertiliser	1	5	0
Silo-Filling Costs	2	3	0
Depreciation on Silo		2	6
Miscellaneous		8	0
Total cost per acre	**8**	**18**	**6**

Average yield per acre, 9.6 tons.

Average cost per ton silage, 18s. 6d.

Total acreage studied, 85.

Man labour, 1s. per hour.

Horse labour, 6d. per hour.

Tractor labour, 3*s.* 3d. per hour.

In comparing the cost per ton of the three types of silage given above, it is necessary to keep in mind the difference in feeding value of the products obtained. The grass silage, for instance, will be a cake substitute, and about six tons will replace one ton of purchased concentrates, whereas the maize and cereal-legume silages are roughages, and the maize silage is a good deal lower in feeding value than the oat and tare silage.

It will be noted that by far the largest item in the costs is that of labour. The various means of dealing with green crops have already been discussed, and there is little doubt that the introduction of special equipment will reduce the amount of labour involved. Already implements for cutting and collecting short grass, for sweeping it up in the field, and for minimising the amount of labour

necessary to fill the silo, have been introduced.

Modifications in technique are also possible, as for instance drilling the crop in the stubble and thereby obviating the need for ploughing; such modifications will substantially reduce the item of labour costs.

The other possibility for reducing the cost per ton of silage produced is to increase the yield per acre. This can only come about by the judicious but generous use of fertilisers.

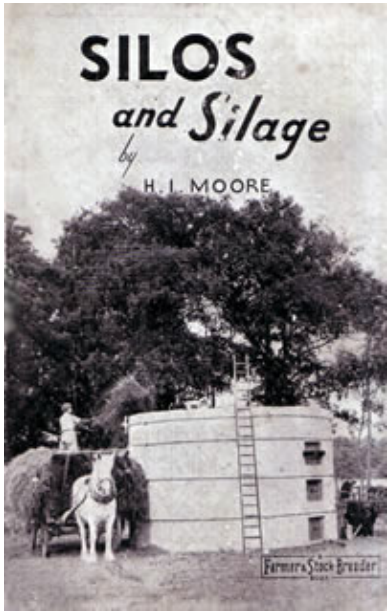
Top Dressings Reduce Costs

Nitrogenous fertilisers in particular should be used on a much more lavish scale, for these crops respond well to nitrogen, and the cost of growing and ensiling a heavy crop is not substantially greater than is required to deal with a moderate crop.

When grass silage is made on dairy farms it is generally

possible to cut the crop, cart it, and ensile between milkings. During this period the men are frequently employed on "time-filling " jobs, and hence under such conditions the cost of the labour involved may be almost negligible.

It is in these circumstances that silage offers great advantages, for it is independent of weather conditions and fits in well with the running of the dairy farm.

APPENDIX I

Before starting to make silage, and even whilst it is being

made, many and varied questions are likely to arise and to require an immediate answer. It is hoped that the answers to most of them will be found in the foregoing pages, but the following questions, which have been asked by farmers in the course of lectures, demonstrations, and advisory work, will serve as both a recapitulation and a conclusion to this account of the principles and practice of silage making.

Shall I make or buy a Silo?	This depends on the tonnage likely to be made. For large quantities of silage a pit should be considered. For small quantities and high-quality crops a container is advisable.
What kind of Silo should I buy?	**First cost, durability, ease of erection, cost of upkeep, and efficiency are the chief points to consider.**

Where is the Best Place to erect a Silo?	**A silo should be erected where it is handy for filling and feeding, especially the latter.**
What Size of Silo should I buy?	**The silo should be of such diameter that the animals will consume a quantity each day equal to a layer of 1 to 3 in. over the entire surface.**
How much Silage should I make?	**This depends on the type of farm and other foods available. To make the fullest use of silage one should plan to make enough high-quality material to feed at least 20 lb. per head per day to the dairy herd all the winter, and 56 lb. of oat and tare or other maintenance silage to all cattle. Some should also be provided for the sheep**

	and young stock.
What Precautions are necessary in Filling?	**Care must be taken to shake up each forkful, tread the whole surface evenly and firmly, and keep the centre high or well-hearted.**
How Mutch should I fill in a Day?	**As a rule 3 to 5 ft. depending on the condition of the crop. Sufficient must be added to allow the greenstuff to heat up.**
What is the Correct Temperature for Silage?	**90 degrees Fahrenheit.**
Do I add Material continuously or intermittently?	**Let each layer attain the desired temperature, whether the filling be continuous or intermittent.**
Is Molasses required for all Crops?	**No, only for young grass, clover, lucerne or sainfoin. It may be used for kale, rape or turnip tops.**

Can I add to the Silo several Times in the Season?	**Yes, but first remove all mould before adding more green stuff.**
Is it always wise to weight the Crop at Night?	**Yes, unless the crop was very wet when ensiled.**
Is it necessary to chop the Crop?	**Not for short material. For long stemmy crops it is advisable wherever it can be arranged, except when using a pit.**
What is the Best Method of Topping Up?	**Sacks or paper to keep the silage clean: then a good covering of soil, and finally a thatch.**
When can I start to use the Silage?	**If necessary almost immediately, but certainly in three to four weeks.**
What is the Best Way of	**Commence at the top and**

Emptying the Silo?	**remove a layer each day.**
How long will Silage keep?	**In an unopened silo for several years. Otherwise, use it fresh each day. Do not keep it out of the silo for more than two days before giving it to the stock.**
Does Silage cause Abortion or Sterility in Cows?	**Certainly not.**
Will it Taint the Milk?	**Not if given after milking and the troughs are kept clean.**
Does the Acid rot the Intestines?	**The idea is ludicrous. The chief acid present is that in sour milk.**

APPENDIX II

Specifications of Silos for home manufacture:—

Wood

Specification of the "I.C.I." polygonal wood silo (p. 54 and 55) is reproduced by kind permission of Imperial Chemical Industries, Ltd., and from this any handyman should be able to construct it. Two sizes are available: one 15 ft. 3 in. diameter, and the other 9 ft. 6 in. diameter.

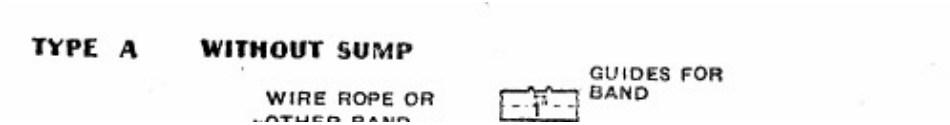
In making this silo the saw cut through the piece of 8 in. x 2 in. is of considerable importance, for this gives the correct angle at which the framing of adjacent panels meet. The panels are bolted together with two nuts and bolts, and a second and third tier can be bolted on if required.

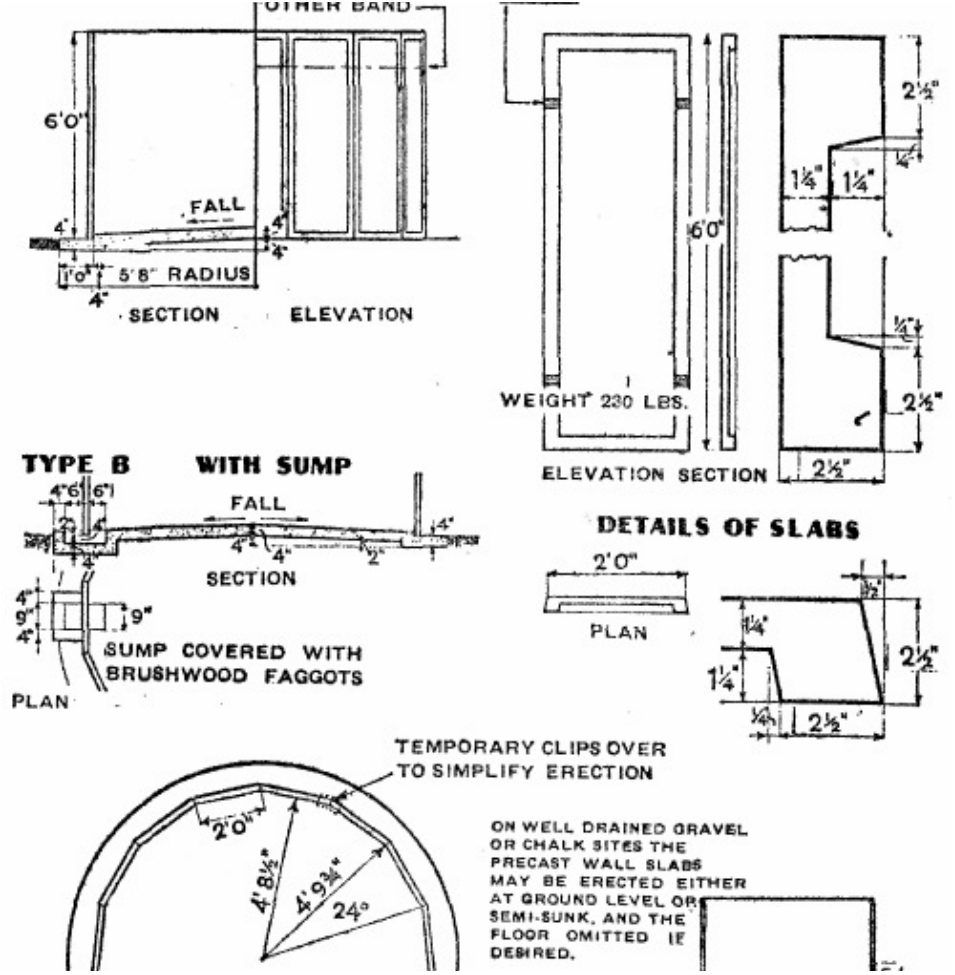
Tongued and grooved boards should be used, and running horizontally they are able to resist any side thrust. All wooden silos should be given an annual dressing with creosote on the outside and when not in use should be stored under cover.

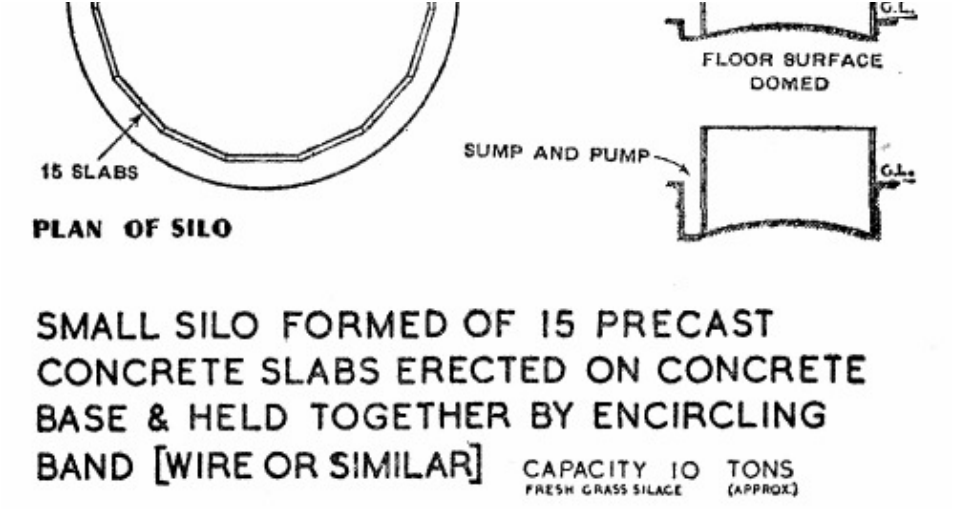
Concrete

On page 108 are given drawings of a concrete silo which is recommended by the Cement and Concrete Association, who kindly supplied details. It is the basis of most designs of concrete silos. Precast concrete slabs are used: they may be home made, but it is practically impossible to obtain the same strength, finish and lasting qualities as in the factory made article.

For slab-making, wooden moulds are, of course, necessary, and recommended proportions are 2 parts clean, coarse sand, 3 parts clean, well-graded shingle or broken stone containing no piece larger than will pass through a 3/8-in. mesh




OTHER BAND
6'0"
FALL
4"
4"
1'0"
5'8" RADIUS
4"
SECTION
ELEVATION
6'0"
WEIGHT 230 LBS.
2½"
1¼"
1¼"
¼"
2½"
ELEVATION SECTION
2½"
TYPE B WITH SUMP
4"6"6"
FALL
4"
4"
4"
2"
SECTION
4"
9"
4"
9"
SUMP COVERED WITH
BRUSHWOOD FAGGOTS
PLAN
DETAILS OF SLABS
2'0"
PLAN
¼"
1¼"
2½"
¼"
2½"
TEMPORARY CLIPS OVER
TO SIMPLIFY ERECTION
2'0"
4'8½"
4'9¾"
24°
ON WELL DRAINED GRAVEL
OR CHALK SITES THE
PRECAST WALL SLABS
MAY BE ERECTED EITHER
AT GROUND LEVEL OR
SEMI-SUNK, AND THE
FLOOR OMITTED IF
DESIRED.



Wire and Paper

Serviceable silos can be produced at very little cost from hurdles, poles and wire netting, and a lining material such as sisalkraft paper or felt.

Hurdle Silo

For making a hurdle silo the following materials will be required : 36 hurdles (18 for the silo and 18 for the over-silo) ; eight 8-ft. posts, 210 ft. of 4-ft. wide lining paper, 12 pegs each 2 ft. 6 in. long and made by nailing two laths together, no yards of fencing wire and some binder twine.

Eighteen hurdles are placed on end to form a circle, and are tied to each other with binder twine at the top, centre, and bottom as shown in the diagram on Plate III. A wire is then passed round the outside of the silo two feet from the bottom. A tourniquet is made in it for tightening the wire when pressure begins to part the hurdles.

Similar wires are fixed round the centre, and the top is kept in position by staples, which are not driven home. Around the inside of the hurdles is placed the paper lining, each ring of which is cut into three equal lengths allowing one foot for overlap at each joint. This will allow for expansion as the silage settles. The lining is kept in position temporarily with the wooden pegs.

As filling proceeds the supporting wires should be so tightened that the silo takes the shape of half a barrel, *i.e.,* the top is wider than the bottom, for this will allow the silage to settle better. When the bottom tier is filled the over-silo of 18 hurdles is erected in the same manner as the first tier, and can be held in position temporarily by lashing eight upright spars from the middle of the silo to the middle of the over-silo. Three bracing wires are necessary for the over-silo. When completed the silo is topped off in the usual way and the over-silo is removed as soon as settling is complete.

Wire Netting Silo

Another simple silo can be constructed of poles, fencing wire, wire netting, and a paper lining. A circle of suitable diameter is marked out on a levelled site. Along the circumference the poles (about 14 ft. long and 3 in. thick) are sunk 18 in. into the ground at approximately 3-ft. intervals. For a 15~ft. diameter silo sixteen poles will be

required.

A strand of fencing wire is then stapled to the inside of the poles 1.5 ft. from ground level, and a further strand about 15 in. above this, the object of these being to prevent bulging and to strengthen the wire netting. 'A circle of netting is then stapled to the inside of the poles, the paper lining—cut into lengths and overlapped 1 ft. at the joints—is clipped to the netting, and the first tier is ready for filling.

A wire round the outside of the poles 3 ft. from ground level will act as a support for the poles, and as filling proceeds this can be tightened by means of a tourniquet. When the first tier is nearly filled a second ring of netting can be fixed as before, again taking the precautions of using two inside wires for strengthening purposes. The bottom of the wire netting should overlap about 4 in. on the inside of the first tier. Furthermore, the paper lining must overlap the first tier of paper. If necessary a third

tier can be erected in the same way. Bulging leads to the formation of air pockets which result in waste silage. Hence this must be guarded against with all improvised silos.

APPENDIX III

The figures in the table on page 112 refer in every case to well made silage. It will be appreciated that the figures will vary considerably according to the measure of success attained in the ensiling of the crop. For those who are not familiar with the terms Dry Matter, .Starch Equivalent, and Digestible Crude Protein the following definitions are given:—

DRY MATTER **is a measure of the real value of the silage, as it expresses the number of lb. of dry food per 100 lb. of silage ready for use.**

STARCH EQUIVALENT **is a measure of the nutritive value in terms of pure digestible starch. It expresses the number of lb. of pure digestible starch equal in energy value to 100 lb. of silage.**

DIGESTIBLE CRUDE PROTEIN **expresses the value of the silage as a source of protein to the animal. It gives the number of lb. of crude protein digested by the animal when 100 lb. of the silage has been consumed.**

Approximate nutritive values of various types of silage

Silage	*Dry*	*As %*	*Dry Matter*	*As %*	*Fresh Silage*
	Matter %	*Starch Equivalent*	*Digestible Crude Protein*	*Starch Equivalent*	*Digestible Crude Protein*
Grass — Autumn (molassed)	25	*50*	6-10	12.5	1.5-2.50

Grass — Mature	25	45	2.5-6.0	11.25	0.6-1.50
Oat and Tare	28	45	9	12.6	2.52
Grass and Clover (young)	21	45	12	9.45	2.51
Grass and Clover (aftermath)	21	45	10	9.45	2.IO
Maize	24	55	5	13.20	1.20
Marrow Stem Kale	16	55	9	8.80	1.44
Sugar Beet Tops	2O	40	7	8.0	1.40
Mangold Tops	22	35	9	7.70	1.98
Turnip Tops	18	55	9	9.90	1.62
Potato	27	73	4	19.71	1. 08

(steamed)					
Pea Cannery Refuse	23	53	7	12.19	1.61
Apple Pomace	20	74	2	14.80	0.40