greatest weight of hay is secured, and probably the greatest amount of nutrients, but the hay is more woody and less palatable than timothy cut earlier.

Orchard grass, western rye-grass, perennial rye-grass, English blue grass, and Johnson grass quickly lose in palatability when nearing maturity, and should be cut for hay before the blooming stage. Other grasses, such as Bromus inermis, redtop and tall oat-grass, retain their good qualities longer, and make good hay if cut when in full bloom or after the blossoming stage. The annual cereal grains, such as barley, oats and emmer, sowed sorghum, and Kaffir, make the best hay if cut when the grain is in the milk or at the soft-dough stage. It is best to cut millet for hay as soon as it is fully headed, before the bloom forms. Cut at this stage, the hay is certainly less woody and more palatable than is the hay made from the more mature millet. The poisonous principle in millet which causes it to be injurious to stock, especially to horses, does not seem to depend upon the condition of the millet with regard to its maturity and the time of cutting. While the less mature millet is better relished, it may seem to give injurious results more quickly.

Clover should be cut just when it is in full bloom, with a few of the blossoms turning brown. If it is cut before this stage, the hay will be lighter and more "washy," especially if fed to horses; while, if the crop is left until the clover is mature, many of the leaves will be shattered or lost in harvesting. This will be a great loss, for the leaves are the most nutritious part of the clover, as they contain nearly two-thirds of the protein in the plant.

Alfalfa should be cut for hay when it begins to bloom. Several experiments conducted at the Kansas Experiment Station, and at other State experiment stations, have shown that alfalfa hay has a higher feeding value when cut at an early stage of maturity, about one-tenth in bloom, than when cut in full bloom. It has also been observed that, when cut at the beginning of the blooming period, the next crop, under favorable soil and weather conditions, starts quickly, and there is no delay in the growth of the alfalfa.

The leaves of the alfalfa are much richer in protein than the stems, and the leaves drop off and shatter worse in cutting if the plants are allowed to become too mature before harvesting. For feeding horses, however, it is advisable, and often recommended, to allow the alfalfa to become more mature and to reach full bloom before cutting. The more-mature hay may be fed to horses with less danger of injurious effects, which sometimes occur from feeding the immature hay.

CURING THE HAY.

The most important factor in making good hay is favorable weather. Hay exposed to excessive rains is greatly injured in quality and in feeding value. This is especially true of hay from leguminous plants, such as clover and alfalfa. Every farmer knows that hay is injured by rain and dew, which cause it to bleach and to mold, and which take from it the natural aroma and palatability essential in hay of good quality. Not all are aware, however, that hay which is cured too much in the sun not only bleaches and loses leaves by becoming too dry, but also becomes lighter in weight and less palatable.

When one cures hay of any kind, he should aim to expose it to the sun no more than is absolutely necessary. The best hay is therefore made by curing it largely in cocks, rather than by leaving it spread over the ground in the swath or windrow. Hay in the swath and windrow is also more exposed to injury by rain and dew than is hay in the cock. Rain not only bleaches hay, thus lowering its market value, but the feeding value of the hay may also be very much decreased.

Hay cures more evenly in the cock than in the swath or windrow. If left too long in the swath, the leaves become thoroughly dry, while the stems still retain a large amount of moisture. Such hay will not cure fully and evenly, and is often put into the stack in a partly-cured condition. If hay is raked before the leaves are dry and placed in cocks, the leaves continue to draw moisture out of the stems, thus allowing the hay to cure evenly.

Clover or alfalfa hay well cured in the cock in this way will keep perfectly in the stack or in the mow. When cured in the swath and windrow, the hay is often stacked in such condition that it may burn or spoil in the stack. Also, the greater breaking of the leaves which must take place in curing alfalfa or clover in the swath and windrow, makes the hay less palatable to stock, and less nutritious than hay which has been properly cured.

A large part of the hay made in the United States, however, is cured in the swath and windrow, or in shocks made up by bunching the hay with the horse rake. When a farmer has a large amount of hay to put up, and little help with which to handle it, he is compelled to do the work in the most rapid and economical way. Putting up the hay directly from the windrow is not only a saving of labor, but it enables the haymaker to do the work rapidly, so that the danger of loss by exposure to the weather is lessened.

In the Central States it is common to cure timothy and clover hay in the swath and windrow, and to put it on the wagon by means of the hay loader, which makes the work more rapid and does away with the hard labor of pitching. In the large alfalfa and prairie-grass fields of the Western States, the common method is to use sweep rakes, by which the hay is taken directly from the windrow to the stacker. Where a large amount of hay is made, it is almost necessary to handle the crop by such a method. The method of curing hay in cocks is more applicable to the small farmer and to farmers who live where the market price of hay makes it profitable to handle it in this more expensive way.

The following general suggestions may be given with reference to making clover or alfalfa hay: As soon as the dew is off in the morning, start the mower; when the hay has wilted somewhat, run it over with a tedder if the crop is heavy and needs lifting; after an interval of a few hours, before the leaves have begun to get dry and brittle, rake the hay into windrows. Allow the hay to remain in this condition for a day or two, when it may be put into the stack or mow. If the plan of curing in cocks is followed, the hay should be placed in small cocks soon after raking. It will be necessary for it to remain in the field for from one to three days of drying weather before it is ready to be put into the stack.

It is possible to start the mower late in the afternoon, cutting until dark, raking the hay the next forenoon, and bunching or cocking as described above. Good hay may be made in this way, since the dew does not blacken the green hay, and even a light rain during the night may not greatly damage it. There is some objection to this method, however, for making clover or alfalfa hay, in that the dew falling on the green hay in the swath seems to favor the development of white mold. Cutting only during the forenoon, after the dew is off, is perhaps the preferable method, provided the farmer can handle the crop rapidly enough in this way.

Hay is much more likely to be injured by the moisture on it than by the moisture in it. This should be an invariable rule: Hay should not be raked or bunched or placed in the stack or mow when there is moisture on it either from dew or from rain. Such hay is likely to mold in the cock or in the mow, and is almost certain to heat, to blacken, or to "burn" in the stack.

Grasses cure much more quickly than do alfalfa and clover. The length of time required for curing grass hay will depend upon the kind of grass, upon the degree of maturity, and upon the weather conditions. In good weather most grass hays may be cut one day and stored the next. It is even possible to cut grass in the forenoon and put it up in the afternoon.

Because hay requires rapid handling, it is not necessary to cure grass hay in the cock in good weather. In showery weather, however, it is a good plan to rake the hay somewhat green, to cock it, and to allow it to cure. Grass hay will shed rain much better in the cock than will clover or alfalfa.

STORING THE HAY.

Hay should be stored in sheds or in barns. Grass hay sheds the rain better than does clover or alfalfa, and may be stored out of doors with little loss, provided the stacks are well made and covered. However, a good hay shed is a profitable investment on any farm. When hay is fed on the farm, the aim should be to store it in a convenient place, so that it may be conveyed to the stock with the least amount of labor. If possible, the hay should be stored, and the live stock fed, under the same roof. This will avoid the expense of handling the hay a second time, and the loss from the breaking of the leaves and heads.

The most rapid way of putting up hay is by the use of sweep rakes and sweep stackers, or swinging stackers. This necessitates stacking the hay in the field where it is cut. This method of putting up hay is best adapted to those regions where hay is made on a large scale. On the average farm, the practical method is to load the hay on wagons, and to haul it to the stack or mow. The hay is rapidly removed from the load and dumped into the mow or stack by means of the hay fork or the hay sling. Slings are often preferable to hay forks for unloading hay, on account of the cleaner and more rapid work which may be done by the use of the sling. For barn or shed storing, a carrier and track is usually most convenient. For field stacking, some form of hay poles, with the pulley and rope, either with or without the track, is in general use.

Hay should not be stacked on the ground, but on an elevated bottom made of poles and brush. If hay is green or unevenly cured, it is apt to "burn" or spoil when there is no ventilation beneath the stack. Great care should be taken to keep the middle of the stack full, so that when the hay settles the stack will shed rain. There is no better grass covering for stacks than marsh hay. When the stack is finished and topped out, one should not fail to bind on the cover with good hangers of wire attached to stones or heavy sticks of wood. As a rule, canvas or board stack covers are troublesome and expensive, and not to be recommended. A farmer might better build a good hay shed than use such temporary means of protecting the stacks from rain. It is often advisable to have a canvas cover or two for temporary use when hay is stacked out of doors.

Although the methods described above are the safest and the most satisfactory, it is a very common practice to put clover hay into the mow in a partially-cured condition, perhaps on the afternoon of the same day the hay is cut. Green or partly-cured clover put into a tight barn will become very hot, but it will not "burn." Such hay may come out in good condition for feeding, but with a brown color which injures the hay for selling on the market. It may be practicable, also, to store clover while green in raised-bottomed sheds, according to the plan which is now being used in Kansas for storing green alfalfa. It is now becoming a common practice in the more humid sections, where the method of farming is intensive, rather than extensive, to protect the hay in the field by covering the cocks with canvas or with paper caps.

Limitations of Profitable Fertilizing.

From experiments carried on at the Rothamstead Experiment Station, and recorded in the current transactions of the Highland and Agricultural Society of Scotland, the conclusion is drawn that, with every system of farming a certain position of equilibrium will be reached (viewed over a term of years long enough to smooth out seasonal effects), when the natural recuperative agencies and the additions of fertilizing material in the manure are balanced by the removals in crops and stock and inevitable waste. The higher the level of production, the greater will be the waste, and, in consequence, the additions of fertilizer must be doubly increased to maintain the balance. How high a level of production for a given soil and climate can be profitably maintained is determined by the prices that rule for the crops, but there will always come a limit when the production can be no longer increased by additions of fertilizer, except at a loss. At such a stage, only the introduction of improved varieties of seed, or some modification of the methods of cultivation that will induce a better utilization of the fertilizer can still profitably increase the production per acre.

On examining the various farming systems in different parts of the country, it will be found that farmers do instinctively adapt their expenditure on fertilizers (including feeding stuffs), and, therefore, their level of production to the magnitude of the returns they can get for their produce. One man will have a large cake bill (linseed cake), and spend 40 shillings per acre on artificial fertilizers during his rotation; he can afford a high level of condition, and, therefore, of waste, in his soil, because he can get good prices for potatoes or barley or sheep, whatever his staple products may be. But, on poorer land, and with less suitable markets, a man may be driven to cut down his cake bill and spend only 10 shillings per acre on fertilizers, because his products are not valuable enough to compensate for the waste that sets in with a higher level of condition in the land. Thus, the problem of what is a profitable manure for a given crop becomes a very complex one, and the biggest factor is perhaps the level of production at which the individual farmer can conduct his business remuneratively.

THE DAIRY.

Fill the Cows with Roughage.

Every summer the question comes up whether it pays to feed grain to cows on grass. More or less data is available on the point, but still it remains an open question, the answer depending upon such factors as the value of grain, the price of milk, the luxuriance and quality of the pastures, and above all, perhaps, upon the cows, their dairy capacity and the care they receive. With cows of beefing tendency grazing good meadows, it would probably be unprofitable to add grain, since it might easily strengthen the tendency to lay on flesh, without contributing much extra to the pail. With highly-bred cows of pronounced dairy temperament, well handled and skilfully milked, so as to stimulate milk production to the extent of the animal's capacity, the case would be different. Speaking of ordinary farm herds, however, we believe it will be recognized as sound policy to use the expensive concentrates, by preference, in the winter season, depending in summer upon pasture and soiling crops. The first principle in cattle-feeding is to fill the animal's paunch at least twice a day with