laid down to grass for six or seven years, and is thus continuously covered by vegetation, the loss of nitric acid by drainage will be reduced to a minimum, and if the grass is *fed off*, the surface soil will at the end of the term be considerably enriched with nitrogen, and with the ash-constituents as well, "but that is another story." The ash-constituents will have been collected from the subsoil by the roots of the grass, and returned to the land in the dung and urine of the cattle. This nitrogen includes the accumulated receipts from the atmosphere and subsoil during the term, minus the quantity lost by drainage and that carried off by the stock. This accumulation of nitrogen will be chiefly in the form of grass-roots, stem, and humus, which, when the land is turned up by the plough, are oxidised, and gradually yield their nitrogen in the form of nitric acid.

When about to use any nitrogenous artificial manure, the farmer cannot be too particular about preparing it. Pulverise it thoroughly, and mix it with at least three times its bulk of finely sifted mould.

Why nitrogen should be of comparatively little use in a turnip-manure, and absolutely indispensable to a crop of mangels or sugar-beets, neither Lawes nor Georges Ville can tell us: but it is so.

NITROGEN IN THE FEEDING OF CATTLE.—The substances containing nitrogen that go to the composition of the animal frame are, generally speaking: 1. albuminoids or protein; 2. gelatinoids, and, 3., horny matter. These three groups are related in composition, though differing a good deal in their properties. The albuminoids form the substance of animal muscle (lean) and nerve, and the greater part of the solid matter of blood. The gelatinoids form the substance of skin and sinew, of all connective tissue, and also the combustible matter of cartilage and bone. Horny matter (*keratin*, from the Greek *keras*, a horn) is the material of which horn, hair, wool, and feathers are constituted.

Sir John Lawes, gives the following percentage composition, as regards the nitrogenous matters, of eight animals, the contents of the stomachs and intestines being deducted:

| | Nitrogen. matter. |
|---|---|
| Fat calf | 15.7 |
| Half-fat ox | 18 1 |
| Fat ox | 15.4 |
| Fat lamb | 13.5 |
| Store sheep | 15.8 |
| Fat sheep | 13 0 |
| Extra fat-sheep | 11.5 |
| Store pig | 14 5 |
| Fat pig | 11.4 |

From the above it will be easily seen that the percentage of nitrogenous matter tends to increase from youth to maturity, but diminishes as the fattening process goes on. The largest proportion of nitrogenous matter is found in the half-fat ox, the smallest in the fat pig.

The following table shows the quantity of nitrogen in the *fasted* live weight of the animals analysed at Rothamsted, the animals, for convenience-sake, being taken to weigh 1,000 lbs. each. We add to this table the articles wool and milk; so that full information as to the loss sustained by the farm, if the animal products is all sold off, may be easily seen:

| | Nitrogen in 1,000 lbs. lbs. |
|---|---|
| Fat calf | 24.64 |
| Half-fat ox | 27.45 |
| Fat ox | 23.26 |
| Fat lamb | 19.71 |
| Store Sheep | 23.77 |
| Fat sheep | 19.76 |
| Store pig | 22 08 |
| Fat pig | 17.65 |
| Wool unwashed | 54 00 |
| " washed | 94.40 |
| Milk | 5 92 |

In this table, the above constituents are reckoned on a fasted live-weight, including the contents of the stomachs and intestines.

Here, it will be remarked, how much richer in nitrogen is the ox than either the sheep or the pig.

As to the loss to the farm, in nitrogen, if the milk is sold; supposing a cow to give 6,000 lbs. of milk in a season, there will be about 35½ lbs. of nitrogen exported; to replace this, in nitrate of soda, would cost, here some thing like $6.40, but in England, the same quantity can be bought for $3.50! If butter is made, there will be no perceptible loss of nitrogen, but with cheese the tale is very different, for in dealing with the above quantity of milk, no less than 28 lbs. of nitrogen will be lost to the farm.

In a fat ox, as generally slaughtered, about 60% of the fasted live weight will be butcher's carcase (1); in a fat sheep, about 58 per cent; in a fat pig, —as pigs are marketed as porkers— about 83 per cent. As for the increased proportion of carcase to live weight while fattening, it was found at Rothamsted that, in store sheep, the average per centage was 53.4; in fat sheep, 58 6; and in very fat sheep, 64.1.

The difference between the percentage of carcase to live weight in sheep and other animals may be partly accounted for by the wool. Many fat sheep carry as much as 15 to 18 pounds of wool, in its unwashed state.

The percentage composition of the increase of sheep and pigs from the lean to the fat state is remarkable:

| | Water. | Nitrogen. matters. | Fat. | Ash. |
|---|---|---|---|---|
| Sheep | 22.0 | 7.2 | 68 8 | 2.0 |
| Pigs | 28.6 | 7.8 | 63.1 | 0.5 |

Bullocks of mature age show about the same composition. No wonder the bones of the pig are so tender when the proportion of ash is so small. And, it will be observed, the increase of fat is enormous: eight to nine parts laid on in fattening to one of nitrogenous matters. Whence comes this immense amount of fat? From the fat of the food and from the carbo-hydrates.

NITROGEN IN THE CONSTITUENTS OF FOOD—The *albuminoids* and the *amides* found in the grain, roots, &c., given to our farm-stock are nitrogenous matters, the fat, carbo-hydrates and salts are non-nitrogenous.

These albuminoids, proteids, are quite similar in composition to those found in milk, blood, and flesh. They may be described as *flesh formers*, and an animal even when not increasing in weight, i. e., when not fattening; will always require a supply of albuminoids in its food to repair the waste of nitrogenous tissue that is always going on. The quantity required for this purpose is but small; an adult man is supposed to need 1¼ oz. a day in his food for this purpose.

When the nitrogenous tissues, or the albuminoids consumed as food, are oxidised in the body, the nitrogen they contain is not burned, but excreted in the form of urea.

(1) Some of the very fattest show-b asts at the London Xmas Exhibition have given as much as 74 %.—ED.

In the usual plants, grains, &c., used for the food of the animals kept on our farms, the following are the percentage of nitrogenous substances:

| | |
|---|---|
| Decorticated cotton-seed cake | 44.0 |
| Undecorticated " " | 20.8 |
| Linseed cake | 27.0 |
| Pease | 22 4 |
| Horse-beans | 25.5 |
| Oats | 12 9 |
| Barley | 10.6 |
| Corn-maize | 10.4 |
| Wheat-bran | 14 5 |
| Brewers grains | 4 9 |
| Fair clover hay | 12.3 |
| " meadow-hay | 9 7 |
| Bean-haulm | 8 1 |
| Oat-straw | 4 0 |
| Pasture-grass | 3.5 |
| Red-clover (before bloom) | 3 3 |
| Potatoes | 2.1 |
| Carrots | 1.3 |
| Mangels | 1.1 |
| Swedes | 1.4 |
| Turnips | 1.0 |

Here it must be observed that some allowance is to be made for variations of practice, climate, &c. For instance: brewers' grains are more valuable here in Canada, on account of the inferior quality of our barley. (1) Meadow-hay in England, where these analyses were made, is a very different thing to a timothy meadow after the clover has died out; the former is full of clovers of different kinds: red-perennial, white or Dutch, yellow or hop, and lots of different grasses.

The nitrogenous substance in the table is obtained by multiplying the percentage of nitrogen by 6.25. No use troubling our readers with the *amides* and the *nitrates* in food.

Variations in the composition of these foods occur from difference of treatment in harvesting; for instance, in regard to meadow hay:

| Cutting. | Nitrogenous matters. |
|---|---|
| May 14 | 17.65 |
| June 9 | 11.16 |
| June 26 | 8.46 |

DIGESTIBILITY OF NITROGENOUS FOOD MATTERS.—Not all the food given to our farm-stock is digestible. In the human subject, it is generally calculated that the constituents of a fair meal are digested in about five hours; but with the ruminants a longer time is occupied in this process; indeed, the ox will not have entirely expelled the meal of Monday morning till the night of the following Friday. This, it will be seen, is one of the principal reasons why the food of the ruminants should contain so large a proportion of what the Americans call "roughage," i. e., straw, &c.

In the case of ordinary meadow-hay, about 57 % of the nitrogenous substance is digested; of clover hay, 55 %; of very good lucerne hay, 74 %; of oat-straw, 35 %; of wheat-straw, only 17 %; but of horse bean-straw, 51 %.

Pease and horse-beans contain about the same percentage of digestible nitrogenous substance, viz., which fully accounts for their very nourishing properties, and for the immense support they afford the cow when her milking powers are exerted to the utmost.

The digestive power of the pig is remarkable. Of every 100 lbs. of nitrogenous substance given in *sour milk*, this animal is capable of digesting 96 lbs., and in two pigs, fed experimentally on green oats and vetches, 48.9 % of the *fibre* was digested: this by the way.—(*To be continued.*)

(1) Brewers know their business better now, in this country, than they did in 1869. The yield of malt then was at least 15 % less here than in England. Hence, the grains were worth more as cattle-food.—ED.

## PRIZE-ESSAYS.

We are happy to be able, at last, to lay before our readers three of the essays that were distinguished as the most meritorious in their class at the competition, held in September last, at the meeting of the Montreal Exhibition Company:

On Butter making, by Mr. Horace Weston Parry, Model-farm, Compton, E. Townships, 1st prize.

On the cultivation of mangels, by R. R. Sangster, Lancaster, Ont., 1st prize.

On Farmyard Manure, by Jas. Dickson, Trenholmville, Q., 1st prize.

### BUTTER MAKING.

In writing on this subject I shall confine myself more especially to the methods practiced in creameries which however apply more or less to the home dairy. The first thing to make sure of in the manufacture of really gilt-edged butter, is that the milk we receive daily is entirely pure and wholesome. This is a difficult thing to do, but if all the patrons are compelled to use aerators, and use them properly, and if the butter maker is most particular in refusing all stale and tainted milk, that object is attainable.

Having received the milk into the vat, it needs all our care and vigilance, to protect the wholesome and favorable germs suspended in the milk from coming into contact with and being inoculated by other unfavorable germs, the production of any body in a state of partial or entire decomposition. This care is essential from the moment even the cow is milked until the moment the butter is consumed.

We will now direct our attention to the proper handling of the milk as it passes through these processes, all of which, if improperly managed, will affect the quality or the quantity of our daily product.

When in the feeding or receiving vat, the milk should be stirred occasionally in order to keep the fat globules, which would naturally be forced to the surface, evenly distributed throughout the entire mass. The milk should be tempered gradually to the temperature desired for separating, as sudden heating makes the milk harder to separate and would not tend to improve the grain of the butter.

The temperature at which to separate depends entirely upon the machine in use and the season of the year. In winter, it may be advisable to separate at a temperature of 80° or 85° F., but in summer, when the weather is warm, it is of great importance to keep the temperature down at every move, and therefore I should advise separating at from 70° to 75°, which will be found to be the temperature of the milk as it is received at the factory. This may necessitate running the milk through somewhat slower than if heated artificially to 80° or 85°, but, as long as the skim-milk tests no more than ⅒, of 1%, the end will justify the means, as the grain and flavor will be the better preserved to the butter, and, Mr. Patron, who grumble because you have to wait so long, your skim-milk won't sour half as easily. The cream should be taken about 15% or should contain 20 to 25 % of butter fat, as thick cream can be churned at a lower temp. than thin.

Having separated our cream, it should immediately be cooled, to as low a temp. as 48° if possible, this will effectually stop all fermentation