DIVISION OF AGRICULTURAL CHEMISTRY.

PROF. F. W. WOLL.

Members of the Experiment Association: I shall not take up much of your time this afternoon for several reasons. First, your Secretary placed my name on the program without asking me whether he might do so or not or without informing me of the fact, so I do not feel that much can be expected of me. In the second place, while I am sure that you have done good work for the state and yourselves in testing varieties of farm crops and in conducting experiments in the culture of different crops, I am not so confident that experiments in the line of agricultural chemistry can be carried on with much profit to yourselves or others with the conditions under which you are working. The culture of farm crops and field trials can be conducted in the ordinary routine of farm work without much extra labor or inconvenience to the grower, but experiments with different fertilizers for the comparison of the value of different feeding stuffs for various purposes call for careful weighings and considerable extra labor, that cannot as a rule be given to it under practical every-day farm conditions. Efforts made in this direction in the past have not, at any rate, been successful. If, however, any of you wish to take up some special experimental work in the study of chemical problems, I shall be glad to assist you individually to the best of my ability.

Professor Moore spoke to you about growing alfalfa, and in this connection I may say a few words as to the possible reduction of the feed bill which may come through a more general culture of alfalfa. The feed bill of the farmers of Wisconsin is very heavy. Many of you may not have given any thought to how much we pay out every year for feed for our farm animals, and especially for dairy cows.

We have in the state of Wisconsin one million dairy cows. It is impossible to tell with any degree of accuracy how much feed is purchased for these cows during the year, but we may
estimate the amount at a minimum of about two pounds per head per day for two hundred days of the year. We know that many good dairymen feed eight to ten pounds of grain a day to their cows, while others feed only a little bran or corn to cows in milk; we may safely assume, however, that two pounds per day per head is considerably below, rather than above, the actual amount fed daily by Wisconsin farmers and dairymen to their cows. Now, two pounds of grain a day for two hundred days to one million cows means four hundred million pounds, or two hundred thousand tons during the year. If we assume that wheat bran is used, since this is the most common concentrated feed purchased by Wisconsin farmers, which is found in every feed store in the state, two hundred thousand tons represents at least three million dollars worth of money. This vast sum is certainly not too high an estimate of the amount paid out every year by our farmers for concentrated feeds to our one million milk cows alone.

It has been shown that the feed bill can be reduced by the use of leguminous crops, especially alfalfa. We have in alfalfa an excellent substitute for at least a portion of the grain ration.

CHEMICAL COMPOSITION AND DIGESTIBILITY OF ALFALFA AND WHEAT BRAN.

Alfalfa hay does not vary greatly in chemical composition from wheat bran. If we consider first the crude nutrients, we note that alfalfa contains 14.3 per cent protein and bran 16.1 per cent and the non-nitrogenous organic substances (i.e., starch, sugar, fibre, and oil, this last component being multiplied by 21/4 to reduce it to its starch value) in alfalfa 72.7 per cent and wheat bran 71.6 per cent. Of the protein in alfalfa hay 74 per cent is digestible, against 79 per cent in bran. The other digestible coefficients are as follows:

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<th>Alfalfa</th>
<th>Bran</th>
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<tr>
<td>Fibre</td>
<td>43</td>
<td>22</td>
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<tr>
<td>Nitrogen-free extract</td>
<td>66</td>
<td>69</td>
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<td>Fat</td>
<td>39</td>
<td>68</td>
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By considering these figures in connection with the crude components in the two feeds we find that alfalfa contains 11.00 per cent digestible protein, against 12.9 per cent in wheat bran, and 42.3 per cent digestible carbohydrates and fat, against 47.8 per cent in bran. Alfalfa hay, therefore, contains in all 53.3 per cent of digestible matter and bran 60.7 per cent.

The results of comparative feeding experiments that have been conducted during the past few years corroborate these findings and show that alfalfa hay is nearly equal to wheat bran, ton for ton, as a food for farm animals. We are justified, therefore, in making comparisons on basis of the approximate figures given, which would suggest that wheat bran may be partly replaced in feed rations by feeding about ten per cent more alfalfa hay than the amount of bran to be replaced.

We shall refer to some experiments in this line that will give some specific information as to the nutritive effect and relative economy of these two feeds.

**EXPERIMENTS WITH ALFALFA.**

In experiments conducted during five years at the New Jersey Experiment Station they obtained an average yield of 19 1/2 tons of green alfalfa from an acre of land, per year, including the first year, and when cured into hay this made 4.8 tons per acre, costing on the average $5.50 per ton. If we figure that bran is worth ten per cent more than alfalfa, ton for ton, this would mean that a saving of over fifty per cent might be effected by replacing bran by alfalfa hay in the rations fed to dairy cows. It would not be advisable of course in feeding heavy producers to do away with the grain feed entirely, but a partial substitution is advantageous and would reduce the feed bill in proportion to the amount of grain replaced.

At the Tennessee Experiment Station it was found that a ton of alfalfa or cow pea hay can be produced at the cost of from three to five dollars and that three to five tons of alfalfa can be produced on an acre of land; with prices as they have to pay, ten dollars for a ton of alfalfa hay and $20.00 a ton for wheat
bran, the saving effected by substituting alfalfa for wheat bran would be $2.80 for every one hundred pounds of butter and 19.8 cents for every hundred pounds of milk. These figures are not directly applicable to our conditions, but they corroborate the conclusions drawn from theoretical reasoning and from practical feeding experiences at other Experiment Stations and on dairy farms.

It seems entirely feasible, by feeding alfalfa, to reduce the feed bill which our farmers have to pay by a considerable amount. If we figure that one-half of the bran fed our dairy cows is replaced by alfalfa hay, it would mean a saving of at least twenty-five per cent in the cost of grain feed for the cows, which at a very low estimate would represent something like three-fourths of a million dollars a year.

OTHER LEGUMINOUS CROPS.

Other crops than alfalfa are of importance and value for this purpose, like clover, soy beans and cow peas, but alfalfa is the most advantageous for Wisconsin farmers. All these plants belong to the botanical family known as legumes. By feeding crops of this family, either as green forage, hay or silage, it is then possible to largely decrease the amount of grain which it is necessary to feed farm stock, especially dairy cows, and by so doing the production of milk and butter may be greatly cheapened.

At the New Jersey Experiment Station a ration which can be readily grown on most farms, composed of soy-bean silage, alfalfa hay and corn meal produced more milk and at a cost of 8½ cents less per hundred than another ration in which the protein was largely supplied by wheat bran, dried grains and cotton seed meal. In another experiment the gain from feeding a home-grown ration of cow-pea hay and corn silage to thirty cows for one month would amount to $37.20 more than a ration in which ⅔ of the protein was supplied in the form of purchased feeds, when milk is selling for one dollar per one hundred pounds.
The advisability of reducing the grain feed by supplying an abundance of rich leguminous feed like alfalfa is apparent from what I have said. There are, however, other factors in favor of feeding leguminous crops. These crops increase the supply of nitrogen in the soil through their power to fix the atmospheric nitrogen so that this costly fertilizer component becomes of direct value to plants. Legumes are furthermore of value to farmers because they are high in protein compounds and produce a rich manure, through the large amount of valuable fertilizing ingredients which they contain.

CHEMICAL COMPOSITION OF ALFALFA AND OTHER CROPS.

The chemical department of our Station last year co-operated with the department of agronomy in making chemical analyses of samples of the crops grown at our Station farms, viz., different cuttings of alfalfa and clovers, and of other forage plants. Some of the results of this co-operative work have been published by Professor Moore in Bulletin No. 121 of our Station. It will be noted from the tables there given that the different cuttings of alfalfa hay contained from 15.9 to 21.3 per cent of protein, and on the average 18.7 per cent, against 13.3 per cent for clover, 4.7 per cent for timothy and 6.1 per cent for bromegrass.

When the weight of hay obtained from an acre of land is considered, we find that alfalfa furnished in the four cuttings, 8,900 pounds of dry matter and 1,996 pounds, or nearly a ton, of protein, against 4,237 pounds of dry matter and 661 pounds of protein in the two cuttings of clover; that is, alfalfa yielded about three times as much protein per acre as clover, and over twice as much dry matter.

In conclusion, I wish to thank you for the kind and patient attention you have given me and to express the wish that the advantage of growing alfalfa in Wisconsin wherever possible may have been brought before you with sufficient emphasis by the preceding figures and by the facts to which I have called your attention in the preceding remarks.