

as compared with other nutrients of the cakes, might be approximately determined.

It is not by any means my experience as a farmer, although it seems to have been Mr. Lloyd's, that the market value of linseed cakes is in proportion to the oil contained in them. Amongst manufacturers and merchants it is common to hear the most sceptical assertions on the value of oil, and farmers have been equally uncertain about it. Moreover, many, and perhaps most farmers rely chiefly, if not entirely, on cakes as a food for their stock, and therefore, in their case, it is not at present so much a question of the best scientific food mixture as the best of two or more cakes.

But now, without making any sort of pretension to be able to meet Mr. Lloyd, or any other scientist, at all equally upon purely theoretical ground, I will yet be rash enough to follow him a little into his own sphere. It appears that, however uncertain practical men may have been on the relative values of fat and the carbo-hydrates in food, in the realms of science there is no such uncertainty. On the contrary, according to Mr. Lloyd, there is nothing more certain with scientists than that a pound of fat is equal to two and a half pounds of carbo-hydrates. Well, what is the evidence for this certainty? And first let us refer to the remarks of Mr. Lloyd himself on the subject. In a little work on "The value of fat as a constituent of the food of animals," Mr. Lloyd, after describing the manufacture of cakes and the constantly increased extraction of the oil from them by improved machinery, asks the following pertinent question:—"Was it the oil contained in these cakes that made them valuable?" He then proceeds to answer his question in the following words:—

"Had the old notion that oil in the cake went directly to form fat in the animal been true, undoubtedly these cakes, when rich in oil, would have possessed great value. But we have seen that this does not take place. What is more remarkable is the fact now proved, that the direct reverse is what happens. Experiments have shown that by increasing the fat in an animal's food the fat in the milk is decreased; and the explanation of this has been found in the fact that fat retards and does not facilitate that decomposition of proto-plasm which results in the production of fat. To the dairy farmer and to the fatterer of live stock this fact is of immense importance, and proves that large quantities of oil in the food are objectionable; hence, instead of being a constituent which materially enhances the value of linseed or cotton cake, it may be deemed, for their purposes, of secondary importance. But if oil has this remarkable power of preventing a waste of the nitrogenous constituents of the body, it is evident that for animals like sheep, which had to wander far to get of scanty herbage, their necessary food, any artificial food which contained oil would be likely to prove of greater advantage than one deficient in oil."

No doubt Mr. Lloyd would say, firstly, that he had qualified his depreciatory remarks upon oil by his exceptions for sheep, with their long wanderings for scanty food. But then the experience of the experimental sheep was, of course, the very opposite of this. And, secondly, he would say that further on in his work he declared the usual faith in the 1 of fat to 2½ of carbo-hydrates. But, then, are not the two statements so irreconcilable as to suggest the greatest uncertainty in the mind of the author? Or, at all events, are not the remarks I have quoted more than sufficient to support the cake manufacturer in his excessive oil extraction and the farmer in his concessions to the practice? Again, that very great German authority, Dr. Emil Wolff, gives the value of the digestible ingredients of foods as follows:—Nitrogenous substances, 2 61d. per lb.; fat, 1 10d. per lb.; and non-nitrogenous substances other than fat, 0 44d. per lb. Do these figures at all agree with those which Mr. Lloyd has given us?

Then, in a standard work upon stock-feeding which I happen to possess, are the following remarks:—"The residue from this process" (extracting the oil from cakes with benzol) "is poorer in oil and correspondingly richer in protein (albuminoids) than that from the ordinary process of pressing, and it seems probable that it would have advantages as fodder over the latter." Then, further on, the same author says:—"Increasing artificially the amount of fat in the fodder by the direct addition of pure fat—e.g., linseed oil—for oxen and hogs, has often been found to have a good effect in increasing the live weight of the animals. . . . By its means, as we have learned, the gain both of flesh and of fat is favoured. . . . The amount of fat in the rations of fattening animals is certainly a point worthy of attention, and it should be our endeavour to increase it as much as can safely be done, especially when the nutritive ration is narrow." I do not say that these statements are not reconcilable in the mind of their author, but I do say that they are not sufficiently clear for the practical grazier who may desire to frame his methods to the best scientific knowledge of the day. In the same work it is in another place admitted that further experiments are very much needed to determine this particular question.

Mr. Lloyd will allow that amongst the best scientific authorities it was long held that one part by weight of fat was equal to two and a-half parts by weight of carbo-hydrates, because all the non-nitrogenous substances of a food were supposed to be chiefly valuable as fuel to supply the requisite heat to the body. The conclusion may still be as stated, although the reasoning which led to it be fallacious.

But it appears to me that with the disappearance of the basis of this supposed law there has disappeared also much scientific certainty upon the conclusion itself which, in the absence of a sufficient number of reliable experiments on which to establish it, is surely not very remarkable. It has since then become known that the fat and the carbo-hydrates have other and very important functions to perform besides the supply of fuel to the animal furnace. Experiments of the most precise and elaborate description have shown that the action of these two substances in the animal body are in many respects very analogous. Both of them supply heat, although it seems probable that the carbo-hydrates are much the more readily consumed. Both also assist in the production of *flesh* as well as of fat. But there is this important difference—that whereas the fat of the food is directly convertible into the fat of the body, it is not yet proved that carbo-hydrates are directly convertible into fat—at any rate, in the case of all kinds of farm animals—although indirectly, they, as well as the fat, do lead to the deposition of body fat. Again, the increase of carbo-hydrates in a food only leads to an increase of fat up to a certain point, unless the albuminoids are also increased; but, so long as the animal can healthily digest it, there is no such limit to the increase of fat in the food. Nor is the digestibility of the companion foods affected adversely by any addition of fat, though such digestibility is greatly depressed by an improper addition of carbo-hydrates. So that the value per unit of any fattening constituent evidently depends, amongst other things, very much upon the total quantities used of each constituent, as well as their relative proportions; and it does not follow, as it seems to me, that the so-called nutritive ratios must always settle satisfactorily the proper food ration. You may have the same ratio with a diet poor in albuminoids as with one comparatively rich in them. So thus it is even more necessary to insist upon a sufficiency of albuminoids than upon a due proportion between them and the carbo-hydrates, etc. Also it is clearly necessary first to settle in all cases the relative value of fat to carbo-hydrates before we can be certain of the terms of our