tance of the food, some have been taken in which the proportion of the nitrogenous to the nonnitrogenous constituents of the food was abnormally high, and others in which it was fairly normal, or even low. In all cases the experiments were conducted for periods of not less than eight or ten weeks, and the amounts, both of total increase and of fat stored up, were so large in proportion both to the original weight of the animal and to the amount of food consumed that the data obtained may safely be relied upon for the settlement of the question at issue.

In the upper portion of Table 70 are recorded some particulars of the nine experiments selected for calculation, namely; The description of the food, the number of animals experimented upon, the duration of the experiment, the original and final live weights, the increase per head and on 100 original weight, the percentage of carcass in fasted live weight, and the amount of crude nonnitrogenous to 1 of crude nitrogenous substance in the food

The middle division of the table shows for 100 increase in live weight the amount of nitrogenous substance consumed in the food, the amount of it estimated to be stored up in the increase, and the quantity remaining and therefore possibly available for the formation of fat. Next, there is given the estimated amount of fat in the increase, the amount ready formed in the food, and the difference, that is, the amount newly formed. There are then given the amounts of carbon in the estimated newly-formed fat, the amounts in the available nitrogenous substance minus that in the urea formed, supposing the whole of the nitrogen not stored up in increase to contribute to such formation; and lastly, the difference, that is, the amount of carbon available from the nitrogenous substance for the formation of fat more or less than that required for the amount of fat produced.

Then, in the bottom division of the table are shown for 100 of carbon in the estimated produced fat the amount available from the nitrogenous substance, and the amount not available from that source, in each experiment; the amount not so available representing, of course, the proportion required from other sources.

It is hardly necessary to point out that, according to the above mode of illustration, the figures show not only the utmost proportion of the stored-up fat which could possibly have had its source in the nitrogenous substance of the food, but notably more than could possibly have been so derived. Thus, to say nothing of other considerations, it has been assumed, for simplicity of illustration, and for the sake of argument, that the whole of the nitrogenous substance of the food not stored up as increase would be perfectly digested and be available for fat formation, and that, in the breaking up of the nitrogenous substance for the formation of fat, no other carbon compounds than fat and urea would be produced; and, lastly, that the whole of the ready-formed fatty matter of the food has contributed to the fat stored up. It is obvious, however, that these assumptions are in part improbable and in part quite inadmissible, while the tendency of the error is, in each case, to show too large a proportion of the stored-up fat to have been possibly derived from the ready-formed fat and the nitrogenous constituents of the food.

It is obvious, therefore, that where

TABLE 70.—*Relation of the total fat in the increase to the ready-formed fatty matter in the food, and of the carbon in the fat produced within the body to that in the nitrogenous substance consumed, in experiments with fattening pigs.*

Experiments	1.	2.	3.	4.	5.	6.	7.	8.	9.
	Bean meal, lentil meal, and bran, each 1 part; barley meal, 3 parts.	Bean meal, lentil meal, bran, and maize meal, each, ad libitum.	Mixture (equal parts) bran and lentil meal, ad libitum.	Maize meal ad libitum.	Barley meal, ad libitum.	3 pounds 3 ounces lentil meal and 9 ounces bran per head per day, and—			
						Sugar ad libitum.	Starch, ad libitum.	Sugar and starch, each ad libitum.	Lentil meal, bran, sugar and starch, each ad libitum.
Conditions and actual results of experiments.									
Number of animals	1	3	3	3	3	3	3	3	3
Duration of experiment, weeks	10	8	8	8	8	10	10	10	10
Original live weight per head.....pounds	103	143	147	144	149	95	95	94	97
Final live weight per head, pounds	191	228	248	217	246	178	178	184	201
Increase in live weight per head.....pounds	88	85	101	73	97	83	83	90	104
Increase on 100 original weight	85.4	59.7	68.9	51.3	64.9	86.4	87	96.8	106.8
Per cent carcass in live weight	82.8	83.9	81.9	85.4	.....	83.1	80.1	81.7	80.8
Nonnitrogenous substance to 1 of nitrogenous substance in food (crude)	3.6	3.3	2	6.6	6	4.1	4.1	4.7	3.9
Per 100 increase in live weight.									
Nitrogenous substance:									
In food	100	107	138	57	64	81	81	74	82
In increase	7.8	6.1	6.7	5.3	6.5	7.1	7.6	8	8.2
Available for fat formation	92.2	100.9	131.3	51.7	57.5	73.5	73.4	66	73.8
Fat:									
In increase	63.1	73.9	69.6	79	71.2	64.3	63.9	62	59.9
In food	15.6	20.4	11.2	26.3	12.4	7.9	7.9	7.3	6.6
Newly formed	47.5	53.5	58.4	52.7	58.8	56.2	56	54.7	53.3
Carbon:									
In newly-formed fat	36.6	41.2	45	40.6	45.3	43.3	43.1	42.1	41
In available nitrogenous substance minus urea	44	48.1	65.6	24.7	27.4	35.1	35	31.5	35.2
More (+) or less (—) in nitrogenous substance than required	+7.5	+6.9	+17.6	—15.9	—17.9	—8.2	—8.1	—10.6	—5.8
Per 100 carbon in estimated newly formed fat.									
Carbon:									
In available nitrogenous substance minus urea	120.2	116.7	139.1	60.5	60.5	81.1	81.1	74.8	85.9
Not available from nitrogenous substance	.....	.....	.....	39.2	39.5	18.9	18.8	25.2	14.1

the figures show an excess of carbon available from nitrogenous substance over that which would be required if the produced fat had been formed from it, the excess is over estimated, and, on the other hand, that where they show a deficiency of nitrogenous substance for such formation, the deficiency is under-estimated; so that, in fact, the amount of fat required to be derived from other sources would be greater than the figures indicate. Indeed, according to the mode of calculation adopted, 100 of nitrogenous substance would yield 62 parts of fat, but it has been fully admitted in subsequent discussions that at most 51.4 parts of fat could possibly be derived from 100 parts of proteid substance, and more recently a much lower figure has been adopted.

After these general remarks we may now turn to the consideration of the results of the different experiments.

In experiment 1, two pigs of the same litter, of almost exactly equal weight, and, as far as could be judged, of similar character, were selected. One was killed at once, and the amount of total dry or solid matter of nitrogenous substance, of fat, and of mineral matter, determined in it. The other was then fed for a period of ten weeks on a mixture consisting of bean meal, lentil meal, and bran, each 1 part, and barley meal 3 parts, given ad libitum. It was then weighed, killed, and its composition determined as in the case of the other animal. In fact, the object of the experiment was to determine the composition of a "store" and of a "fat" pig, and to estimate the composition of its increase while fattening; and the data thus provided have formed the basis of the estimate of the fat in the increase, not only in the case of experiment 1, to which they directly apply, but in that of each of the other eight experiments, the results relating to which are recorded in the table. On this point it may be observed that, taking into consideration the weight and condition of the animals at the commencement, the character of the foods, the length of the fattening period, the proportion of increase upon the original live weight, and the final condition of the animals, it may perhaps be concluded that the tendency of error in the calculations would be to give the proportion of fat in the increase somewhat too high in experiments 2 and 3, and somewhat too low in experiments 6, 7, 8, and 9. In experiments 4 and 5, however, the animals were the fattest in the series; and it will be seen further on that the high estimates of fat in the increase in their case are probably not too high—indeed, in experiment 5, even somewhat too low.

It might be supposed that—at any rate in the case of experiment 1—the results would be admirably adapted for our present purpose. But that experiment was made in 1850. That is nearly forty-five years ago, and before we had acquired sufficient evidence against the view then prevailing, namely, that the increase of the fattening animal was largely dependant on the richness of the food in nitrogenous constituents, and everybody having experience in the fattening of pigs will admit that in this case the food was much more highly nitrogenous than is recognized as most favorable for the fattening of the animal. In fact, it is seen that the proportion of the crude nonnitrogenous to 1 of crude nitrogenous substance in the food was only 3.6 instead of about 6 as in barley meal. There was, therefore an excess of nitrogenous substance consumed.

Referring to the middle division of the table, the calculated results show that, for 100 increase in live weight 100 of nitrogenous substance was consumed in the food. Of this it is estimated that only 7.8 parts were stored up in the increase, leaving 92.2 parts available for the possible formation of fat.

It is next seen that the 100 of increase was estimated to contain 63.1 parts of fat, while the food supplied only 15.6 parts, leaving, therefore, at least 47.5 parts to be produced within the body. The figures show that this would require 36.6 parts of carbon, while 44 parts are estimated to have been available from the nitrogenous substance of the food; leaving, therefore, according to the mode of calculation adopted, 7.4 parts more carbon available than were required for the formation of the fat, for 100 carbon in the estimated newly-formed fat, 120.2 parts were available from the nitrogenous substance consumed in the food.

(To be continued)

Orchard and Garden.

HORTICULTURE at the CENTRAL EXPERIMENTAL FARM,

Orchards—Raspberries—Pears—Apples—Protected plants.

The Report of the Horticulturist of the Central Farm, Mr. John Craig, has been received. This is included in the Annual Report of the Farms, but a limited number of copies are struck off separately for the special use of the author.

The Report makes an interesting illustrated pamphlet of 60 pages. All the subjects treated and experiments tried are of practical importance to