struction of diagram II which shows the relative amounts of the substances consumed in the different experiments to produce 100 pounds increase in live weight.

Referring to the results, and first to those represented in Diagram I, which shows the relative amounts consumed per 100 pounds live weight per week, a glance brings strikingly to view the fact that there was no uniformity whatever in the amounts of nitrogenous substance so consumed in the thirty different cases, representing as many different rations. Indeed, it is seen that the amounts ranged in the proportion of 100 to more than 300, with very great variation between these amounts. The range in the nonnitrogenous substance so consumed is, on the other hand, very much less, reaching, in but few cases, from 100 to 150 Lastly, in the case of the total organic substance the range is less still.

Next, referring to Diagram II, showing the relative amounts of the different constituents consumed to produce 100 pounds increase in live weight, there is again no uniformity in the amounts of nitrogenous substance so consumed. There is, however, great uniformity in the amounts of the nonnitrogenous substance consumed; and there is, in the majority of cases, about the same uniformity in those of the total organic substance consumed.

It should be understood that in these diagrams relating to pigs as in the table relating to the experiments with sheep it is the amounts of the crude nitrogenous, the crude nonnitrogenous, and the crude total organic substance as determined by the methods of analysis already described, and which were the only ones practicable at the time, that are represented. Of course, therefore, the indications of the actual results have, as in the case of those with sheep, to be interpreted with due regard to the known facts in each case. But, to meet objections, we, nearly twenty years ago, recalculated the results and reconstructed the diagrams, making correction for indigestible or nonavailable constituents in the various foods, in accordance with the then published tables of Prof. Emil von Wolff, and more recently, as in the case of the experiments with sheep, we have had them again recalculated according to his more recent tables, already referred to.

It may be stated that the diagrams, as first reconstructed, entirely confirmed the conclusions previously drawn; and, indeed, illustrated the points brought out by those at first, and now again given even more strikingly still; that is, they showed a wider range in the amounts of the nitrogenous substance consumed in the different experiments; with one or two easily explained exceptions, a less variation in the amounts of the nonnitrogenous substance, and especially a less range in the amounts of total organic substance consumed. The two methods showed, moreover, with some obviously necessary exceptions, comparatively little difference in what is called the "nutritive ratio;" that is, the relation of the nonnitrogenous to the nitrogenous constituents. As it is impossible on this occasion to give and discuss both sets of results, it seems best, after this explanation, to adhere to the originally obtained and recorded results which led to the conclusions arrived at so long ago, rather than to adopt corrections based upon factors as yet not sufficiently established. Nevertheless, it is satisfactory to find that, applying the best methods of correction which subsequent investigations suggest, the conclusions formerly drawn are confirmed and emphasised, rather than in anyway vitiated or modified.

In conclusion, in regard to this branch of the subject, it must be considered established that, taking ordinary food stuffs as they go, neither the amount consumed in relation to a given live weight of the animal within a given time (which, of course, in the fattening animal covers the requirements for increase as well as for sustenance), nor the amount consumed to yield a given amount of increase in live weight (which covers the requirements for sustenance also) was at all in proportion to the amount of the nitrogenous constituents supplied. It is, on the other hand, obvious that the consumption, both for sustenance and for increase, was much more nearly in proportion to the amount of the digestible and available nonnitrogenous constituents supplied, but that it was more nearly still regulated by the amount of the total digestible organic substance—nitrogenous and nonnitrogenous together—which the foods supplied. The indication is, indeed, as will be more clearly seen further on, that if there be a deficiency of available nonnitrogenous constituents, an excess of the nitrogenous may to a certain extent take the place of the nonnitrogenous: that, in fact, within certain limits, the two classes of constituents may, for the purposes of respiration and fat formation, mutually replace each other.

When the character of the main products of respiration and the prominence, in a quantitative sense, of the respiratory function in the maintenance of the body are considered, it seems only what might be expected, that the consumption by a given live weight of animal within a given time should be regulated more by the supplies in the food of the oxidable nonnitrogenous than of the nitrogenous or more specially flesh-forming constituents; and now that it is known, as I shall further on have to show is the case, that in the exercise of force the respiratory action is enormously increased, while that of nitrogenous transformation is but little augmented, the result is rendered still more consistent and intelligible.

That the increase in live weight of the animal should (provided the food be not abnormally poor in nitrogenous substances) also be regulated more by the supplies of the nonnitrogenous than of the nitrogenous or flesh-forming constituents, does not at first sight seem so intelligible.

There is, however, no doubt of the fact that our current fattening rations are, as such, more valuable in proportion to their richness in digestible and available nonnitrogenous than to that of their nitrogenous constituents. At the same time, as the manure is valuable largely in proportion to the nitrogen it contains, there is, so far, an advantage in giving a food rich in nitrogen, provided it is other respects a good one, and, weight for weight, not much more costly. But since in recent years the vegetable products most benefited by nitrogenous manures have been so largely imported as much to reduce the value of the home grown crops, even this advantage of highly nitrogenous food stuffs is becoming of less importance, and that of having the best food for the progress of the animal one of more and more consideration.

The question obviously suggests itself. Of what does the increase of the animal chiefly consist? To experimental evidence on this point I propose next to direct attention.

TABLE 68. — *Percentage composition of the carcasses, the offal, and the entire bodies of ten animals of different descriptions, or in different conditions of maturity.*

Description of animal.	Mineral matter (ash)	Nitrogenous substance.	Fat.	Total dry substance.	Water.	Contents of stomachs and intestines (in moist state).
Carcass:						
Fat calf	4.48	16.6	16.6	37.7	62.3	....
Half-fat ox	5.56	17.8	22.6	46	54	....
Fat ox	4.56	15	34.8	54.4	45.6	....
Fat lamb	3.63	10.9	36.9	51.4	48.6	....
Store sheep	4.36	14.5	23.8	42.7	57.3	....
Half-fat old sheep	4.13	14.9	31.3	50.3	49.7	....
Fat sheep	3.45	11.5	45.4	60.3	39.7	....
Extra-fat sheep	2.77	9.1	55.1	67	33	....
Store pig	2.57	14.	28.1	44.7	55.3	....
Fat pig	1.40	10.5	49.5	61.4	38.6	....
Means of all	3.69	13.5	34.4	51.6	48.4	....
Offal (excluding contents of stomachs and intestines):						
Fat calf	3.41	17.1	14.6	35.1	64.9	....
Half-fat ox	4.05	20.6	15.7	40.4	59.6	....
Fat ox	3.40	17.5	26.3	47.2	52.8	....
Fat lamb	2.45	18.9	20.1	41.5	58.5	....
Store sheep	2.19	18	16.1	36.3	63.7	....
Half-fat old sheep	2.72	17.7	18.5	38.9	61.1	....
Fat sheep	2.32	16.1	26.4	44.8	55.2	....
Extra-fat sheep	3.64	16.8	34.5	54.9	45.1	....
Store pig	3.07	14	15	32.1	67.9	....
Fat pig	2.97	14.8	22.8	40.6	59.4	....
Means of all	3.02	17.2	21	41.2	58.8	....
Entire animal (fasted live weight):						
Fat calf	3.80	15.2	14.8	33.8	63	3.17
Half-fat ox	4.66	16.6	19.1	40.3	51.5	8.19
Fat ox	3.92	14.5	30.1	48.5	45.5	5.98
Fat lamb	2.94	12.3	28.5	43.7	47.8	8.54
Store sheep	3.16	14.8	18.7	36.7	57.3	6
Half-fat old sheep	3.17	14	23.5	40.7	50.2	9.05
Fat sheep	2.81	12.2	35.6	50.6	43.4	6.02
Extra-fat sheep	2.90	10.9	45.8	59.6	35.2	5.18
Store pig	2.67	13.7	23.3	39.7	55.1	5.22
Fat pig	1.65	10.9	42.2	54.7	41.3	3.97
Means of all	3.17	13.5	28.2	44.9	49	6.13

COMPOSITION OF OXEN, SHEEP, AND PIGS, AND OF THEIR INCREASE WHILE FATTENING.

I propose to show the composition of some of the animals of the farm in different conditions as to age and fatness; to estimate the probable composition of their increase in live weight during the fattening process; and to show the relation of the constituents stored up in the increase to those consumed in the food. The results which have been obtained will also afford data for the discussion of the question of the sources in the food of the fat produced in the animal body; they will further supply evidence as to the composition of the manure in relation to that of the food consumed; and lastly they will lead to a consideration of the characteristic food requirements of the body in the exercise of force.

To determine the ultimate composition, and in a sense the proximate composition also, of oxen, sheep, and pigs, and under such conditions that the results obtained should served as data for the estimation of the probable composition of their increase while growing an fattening, 10 animals were selected for analysis, namely: a fat calf, a half-fat ox, and a fat ox; a fat lamb, a store sheep, a half-fat old sheep, a fat sheep, and an extra-fat sheep; a store pig, and a fat pig.

Table 68 (p. 334) shows the percentages of mineral matter, of nitrogenous compounds, of fat, of total dry substance, and of water, in the upper division in the collective carcass parts, in the middle division in the collective offal parts (excluding contents of stomachs and intestines), and the lower division in the entire bodies of the 10 animals. The weight of the contents of stomachs and intestines is also given.

It may in the first place be observed that, comparing one animal with another, all the results tend to show a prominent connection between the amount of total mineral matter and that of the nitrogenous constituents of the body; there being a general tendency to a rise or fall in the percentage of mineral matter with the rise or fall in that of the nitrogenous compounds.

Comparing the composition of the different carcasses, it is seen that there was, in every instance excepting that of the calf, a considerably higher percentage of fat than of total nitrogenous substance.

In the carcass of even the store or lean sheep there was more than one and a half times as much fat as nitrogenous substance, and in that of the store or lean pig there was twice as much. In the carcass of the half fat ox there was one-fourth more fat than nitrogenous matter, and in that of half fat old sheep there was more than twice as much.

Of the fatter animals, those assumed to be in a suitable condition for sale as human food, the carcass of the fat ox contained two and one third times as much, that of the fat sheep