experiments with milking cows but gave in some detail the particulars and results of ten experiments with the horse. The normal food being hay, straw, and oats, he in one case substituted half the hay by potatoes, in another by Jerusalem artichokes, in another by mangels, in another by ruta-bagas, and in another by carrots. Again, in another the straw and oats were replaced by potatoes; in another half the hay was replaced by more oats and straw, and so on. In each case he noted the change in weight and condition of the animals in other respects, if any; and he judged accordingly whether the amount of the food given in substitution was too much or too little, and whether, therefore, the practical or the theoretical results were the most to be relied upon.

He brought together in a table (1) the estimates of the value compared with 100 of hay of the seventy-six different articles of food according to the amount of nitrogen he found in them; and side by side he gave the hay value of the foods according to the published estimates of others, and to the results of his own practical trials.

Subsequently, however, Boussingault was not satisfied with his results so obtained, and he pointed out that what was still wanting was the determination of the amount of the various nonnitrogenous constituents also, and of how much of them was digestible, and how much indigestible; and eventually he determined in ninety different food stuffs, not only the nitrogen, but the mineral matter, the woody fider or cellulose, the fatty matter, and (probably by difference) the remaining nonnitrogenous matters, which he recorded as starch, sugar, and allied bodies. As to the nitrogen, he still, as formerly, multiplies the amount found by 6.25 to represent albumin, legumin, or casein.

He also still took 100 parts of hay as the standard by which to compare the nutritive value of other foods; as for ruminants and horses he considered it a good standard food, and that the relation in it of the nitrogenous and the digestible nonnitrogenous constituents was fairly normal. He now, however, modifies the meaning of the equivalent arrived at by taking into account the amount of digestible nonnitrogenous substance associated with the standard amount of nitrogen in each case; and, if there were a deficiency, he states how much of some food rich in digestible nonnitrogenous matters should be added to complete the equivalent, and so make it comparable with the 100 of hay. Indeed, he now laid it down that equivalent rations must contain equal amounts of digestible nonnitrogenous, as well as of the nitrogenous bodies.

In the case of the ninety descriptions of food which he analyzed as above referred to, he gives a table (2) recording the results obtained and then shows the amount of each food required to contribute the same quantity of nitrogenous substance as 100 of hay. Next he calculated how much nutritive nonnitrogenous matter, reckoned as carbohydrate of 42 per cent carbon, was supplied in the amount of each food containing the nitrogen of 100 of hay. If the amount were less than in 100 of hay he calculated how much straw was required to supply the deficiency, assuming straw to contain 45 per cent of such matter. The final result shows not only the same amount of nitrogenous, but as much of digestible nonnitrogenous substances also as 100 of hay. If, however, the nitrogen equivalent of the food contained an excess of digestible nonnitrogenous constituents he did not make any corresponding deduction from the ration.

Boussingault fully recognized that food equivalents so calculated are only satisfactory in comparing foods of the same description, which he classifies generally as follows: (1) Hays and straws, (2) roots and tubers, (3) oily seeds, (4) cereal grains, leguminous seeds, oil cakes, etc. He pointed out that when the application of the tables is thus limited they are very useful in showing how one food may be advantageously substituted for another of the same class, according to relative abundance cheapness, and so on.

In conclusion, in regard to Boussingault, in giving a sketch of the history of the progress in our knowledge of the subject of the feeding of the animals of the farm it was only due to him to give prominence to his enormous, painstaking, and most conscientious labors in regard to it. This is the case, independently of any direct applicability of his results and conclusions at the present time, because he was essentially the pioneer, and his conceptions and methods have had a very marked influence on the direction of subsequent investigations.

It was in 1842, that is after Boussingault's first systematic discussion of the subject, but before his second, that Liebig published his work entitled "Chemistry in its Applications to Physiology and Pathology." In it he treated of food in its relations to the various exigencies of the animal body, and, apparently impressed as was Boussingault, with the fact that nitrogenous constituents were both essential and characteristic of the animal body, and that they must, therefore, be supplied in the food they consumed, and in the case of the Herbivora in vegetable food stuffs, he also, like Boussingault, indeed probably directly influenced by his results and conclusions, himself concluded that the comparative values of food stuffs, as such, were, as a rule, measurable by their richness in the nitrogenous, rather than in that of the nonnitrogenous constituents—that is to say, more by their flesh-forming than by their more specially respiratory or fat-forming capacities. Thus he says (p. 45):

"Chemical researches have shown that all such parts of vegetables as can afford nutriment to animals contain certain constituents which are rich in nitrogen, and the most ordinary experience proves that animals require for their support and nutrition less of these parts of plants in proportion as they abound in the nitrogenous constituents."

Again, at page 369 of the third edition of his Chemical Letters (1851), he says:

"The admirable experiments of Boussingault prove that the increase in the weight of the body, in the fattening or feeding of stock (just as is the case with the supply of milk obtained from milch cows), is in proportion to the amount of plastic constituents in the daily supply of fodder."

Liebig would probably be somewhat biased in favor of the conclusion here stated by the view he held, that the amount of force exercised in the animal body was measurable by the amount of nitrogenous substance transformed, and this again by the amount of urea found in the urine. To Liebig's views on this latter point, as well as on the question of the sources in the food of the fat of the animal body, and on some other points of scientific, as well as practical interest, I shall have to refer further when considering each of these several questions independently. In the meantime, my special object is to show what were the prevailing opinions on the subject of the adaptation of foods according to their composition, to the sum of the requirements of the animals of the farm, which include not only those for the mere maintenance of the body, but those for increase in live weight, for the production of milk, or for the exercise of force, as the case may be. It was however, not only in regard to the foods of the animals of the farm, but to human foods also, that the system of estimating their comparative value according to their percentage of nitrogen came to be applied. Thus, different descriptions of flour and bread, and numerous other aliments, both vegetable and animal, were examined, and their comparative food values were assumed to be indicated by their richness in nitrogen.

(To be continued.)

(1) Rural Economy, etc. (English edition), 1845 H. Baillière, London.

(2) Economie Rurale, Deuxième édition, 1851, vol. 2, pp. 356-363. Paris.

The Flock.

ANTIQUITY OF THE COTSWOLD SHEEP.

In the course of an interview, with a representative of the *Cable* Mr. Arthur Acock (of the firm of Acock and Tayler, auctioneers, of Cold Aston, Cheltenham), gave the following interesting particulars of the history of the Cotswold sheep:—"The breed is supposed to be named from the cots (1) or sheds in which they were housed at night, or permanently in the winter, and the Wolds or open hilly grounds on which they pastured in summer. The breed is, of course, of great antiquity. It was distinguished as far back as the reign of Henry VI. In 1437 application was made to Henry VI, by the then King of Portugal for leave to export sixty sacks of Cotswold wool, in order that he might manufacture certain cloths of gold at Florence for his own use. Stowe, under date of 1467, wrote: 'Sheep transported into Spain.' In this year King Edward IV, gave a licence to pass over certain Cotswold sheep into Spain, by reason whereof it has come to pass at this day that the staple of the woollens, of Spain, except at Bayeles (Bruges) in Flanders, is so great that our staple is not comparable to it. Markham, in Elizabeth's reign states that the Cotswold sheep were, as they continued in every period of their early history, 'A long woolled and large boned breed.' "There" (added Mr. Acock) "you get the feature." (2)

(1) The *wold*, in the word "Cotswold" is the Anglo-Saxon word. *weald*=a *wood*. The *cot* is the Keltic *coed*, also=a *wood*; two synonymous elements, like the river, mentioned in Rob Roy, the *Avondow*, in which both *Avon* (afon) and *dou* (dwr) are Keltic for water.—ED.

(2) Master Slender *chaffs* Justice Shallow about his "Fallow dog" having been out-run on *Cotsale*. See "Merry Wives of Windsor."—ED.

BREEDS OF SHEEP.

The varied character of British stock is perhaps nowhere more strikingly manifest than in the number of breeds for which prizes are offered at the Royal Agricultural Society's show. In 1893 prizes were offered at Chester for 23 distinct breeds as follows:

Leicester.
Border Leicester.
Cotswold.
Lincoln.
Oxford Down.
Shropshire.
Southdown.
Hampshire Down.
Roscommon.
Limestone.
Cheviot.
Black-faced Mountain.
Suffolk.
Somerset and Dorset Horn.
Kentish or Romney Marsh.
Devon Longwood.
Ryeland.
Dartmoor.
Exmoor.
Wensleydale.
Herdwick.
Lonk.
Welsh Mountain.

These are not sub-varieties caused by local crossing, but distinct local breeds handed down from father to son for generations and each with specific differences well known to experts. No doubt local peculiarities of soil and climate are influential in originating and perpetuating these distinctions, but they are well known to have distinct points that are maintained no matter where they happen to be located. The Leicesters and Border Leicesters may be mentioned as an example. The rival merits of these two breeds, which have been handed down for a century quite distinct were only last year very sharply contested by their various admirers. The number of distinct breeds is, however, gradually being curtailed, as the allied breeds show points of excellence that entitle them to preference. In 1839 the list for which prizes was offered at the Royal was as follows:

Leicester (Dishley).
Lincoln.
Teeswater.
Cotswold.
Romney Marsh.
Bampton Notts.
South Ham Notts.
Irish (polled).
Southdown.
Wiltshire.
Shropshire Morfe. (1)
Delamere Forest.
Herdwick
Cheviot.
Scotch (black-faced)
Merino.
Dorset.
Portland.
Exmoor.
Dartmoor.
Cornish.
Ryeland.
Dean Forest.
Mendip.
Norfolk.
Cannock Chase.
Penistone.
Shetland.
Welsh Mountain.
Wicklow Mountain.
Kerry.

(1) A very different sheep from the present Shropshire the latter was first admitted to the R. ...'s list at the Glo'ster Exhibition, 1832.

Spring Chickens Receive Attention at declining prices, but otherwise the poultry trade is about as dull as usual at this time of year. Turkeys quite neglected at low figures around 8a9c l. w. The season is so far advanced that spring chicks command only a small premium over hens. Country shippers should keep at home everything weighing under $1\frac{1}{2}$ lbs.