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## AGRICULTURAL PHYSIOLOGY.

### REVIEW.

SCOTLAND has long been celebrated for her advanced state of agricultural knowledge, and for the zeal which has been there exhibited for the improvement of the art. So early as the year 1723, "A Society of Improvers in the Knowledge of Agriculture in Scotland" was established, and several volumes of its transactions were published. In 1755, this Society gave place to another, which in its turn was succeeded, in 1784, by the "Highland and Agricultural Society of Scotland,"—a society which has occupied, and still so justly occupies, the highest position among all the other agricultural societies in the northern portion of the United Kingdom, and is second to none in Britain for its efforts in promoting the cause of agricultural improvement.

To the exertions both of these societies, and of many enterprising individuals, joined to the industry and intelligence of her sons, must it be owing that Scotland has been for a long period, in a more advanced state of agricultural improvement, than any other portion of the British dominions.

In paying this well-merited compliment to the Scottish farmer, he would totally mistake our meaning were he to suppose for a moment that we consider his system of agriculture even bordering upon a state of perfection. During the last few years, he is too well aware that his relation to other grain pro-

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Review of T. L. Kemp's 'Agricultural physiology', 1850. [Signed C.]

ducing countries has been totally changed. Free trade has thrown the whole world into open competition with him; and that British farming had not arrived at such a state of perfection as to have made the introduction of such a measure expedient, seems now to be acknowledged even by its chief promoters.

It appears, however, equally certain that foreign competition will prove such a stimulus to the improvement of agriculture, that a future generation may have reason to smile at our cry for a return of protection.

We cannot shut our eyes to the fact, that farming has improved more in three years under free trade, than in ten years before that measure became the law of the land. Difficulties must exist before they require to be surmounted; and that in this case they will be surmounted, we have the greatest reliance on the energy, intelligence, and perseverance of the British farmer.

Already men of all ranks and professions, who might never have been led to direct their attention to the subject, are putting their shoulders to the wheel, and by their wealth or their learning are using every effort to rescue the practice of agriculture from empiricism, to put its study on a surer footing and to raise it to its proper rank among the sciences. In the southern portion of the kingdom, every new experiment is tried to make the ground produce more grain, to make it keep more cattle, and keep them better than it has hitherto done. The different breeds are improving every day. The fattening of stock is accomplished in much shorter time, and with far less waste of food than hitherto. There is much more economy in the collection, and much greater knowledge displayed, in the application of manures; in short, everything connected with farming is improving with rapid strides.



We wish we could see the spirit of agricultural progress as visible and as general in our northern part of the kingdom. Many and great, no doubt, have been the improvements in reclaiming waste land, in draining, and, to some extent, in improving the breeds of cattle, during the last ten years; but let any one who *really* possesses a knowledge of practical and scientific farming, take a cursory glance over our northern counties, and he will see, at almost every farm, the strength of the solid manure carried off by the winds, and washed out by the rains, the liquid manure (valued at £4 or £5 per annum for each animal) totally running to waste; he will see the feeding of cattle conducted on a ruinous and false system, at the very best farms; and he will see the small farms overstocked with cattle, which are, and will continue to be, *half starved*, so long as the present mode of management is pursued; these cattle in most cases being thick-skinned, pot-bellied, crooked-backed, mongrel brutes, that will neither feed, fill the pocket, nor enrich the land. Then, again, the fact is completely lost sight of, *that this is not a dairy country*; the housewife, instead of suckling her calves as she ought to do, and sending her produce to market on the backs of her black cattle, foolishly expends her labour in the manufacture of butter and cheese.

All this may be answered by saying that "this is a poor country—the soil is poor—the farmers are poor—compared to those in the southern portion of the kingdom, and free trade has made matters worse; we cannot, therefore, afford the means of adopting all these improvements, had we even the knowledge necessary to enable us to do so."

But, "where there is a will there is a way," and he would be a very short-sighted landlord who would refuse to give some encouragement, if he saw his tenant anxious to meet the alter-

ation of his circumstances by adopting a more scientific and improved system of farming:

Our opinion decidedly is, that the most certain way of overcoming the present difficulty—of meeting the foreigner on equal terms, in the grain market and in the cattle market—in short of *protecting* ourselves, is by diffusing a knowledge of scientific agriculture among the farmers of this country.

As it is of consequence in other kinds of warfare to know the strength of the enemy's camp, so may it be useful in inciting to increased exertion on our part, to take a glance at the means of agricultural improvement among some of our continental neighbours:—

In France, there are many schools, aided by the State, for teaching both practical and theoretical agriculture to the rising generation of farmers. At Grignan, in the department of Drôme, in one of the old royal palaces, with a domain of 1185 acres for a model farm, the branches taught are the following:—

- 1st.—The rational principles of husbandry.
- 2d.—The principles of rural economy applied to the employment of capital and stock of a farm.
- 3d.—Arithmetic and agricultural book-keeping.
- 4th.—The construction of farm buildings, roads, and farming implements.
- 5th.—Vegetable physiology and botany.
- 6th.—Horticulture.
- 7th.—Forest science.
- 8th.—The general principles of veterinary surgery.
- 9th.—The laws relating to property.
- 10th.—Geometry, applied to surveying and land-measurement.

- 11th.—Geometrical drawing.  
 12th.—Physics, as applied to agriculture.  
 13th.—Chemistry, as applied to the analysis of soils,  
 manures, &c.  
 14th.—The general principles of mineralogy and geology.  
 15th.—Domestic medicine, applied to the use of husbandmen.

The professors are paid by Government; and the pupils pay from £36 to £48 a-year, according to the classes attended.

In most parts of Germany, institutions for the improvement of agriculture have been founded, and are supported by the State.

In Prussia, there is an Agricultural Academy, with a public Model Farm attached, in almost every province. There is a College about forty miles from Berlin, founded by the late king, with a Model Farm of 1200 acres.

In the kingdom of Wurtemberg, near Stuttgard, there is an Agricultural College with a Model Farm of 1000 acres, to which are attached twelve Professors, who deliver Lectures on Mathematics, Physics, Chemistry, Botany, Technology, Tillage, and other departments of Rural Economy, Forestry, and the Veterinary Art.

In Bavaria, the large domain attached to the Royal Palace of Schlessheim has been given up for a Model Farm.

In several other countries of Europe, we find Agricultural Institutions, established and supported by the State, devoted to the encouragement and improvement of the practical and theoretical parts of the science.

Let this information stir up a spirit of rivalry among all interested in the progress and prosperity of British agriculture. Let there be a properly conducted Model Farm on every large estate; and since Government seems indisposed to come to their

aid, let landlord and tenant join heart and hand in raising Agricultural Associations on a new footing, and let their object be to diffuse a knowledge of scientific farming throughout the land—for “God helps them that help themselves,” as poor Richard says.

Let these Associations secure the services of some one who is able to teach them what farmers generally are totally ignorant of—the A, B, C, of scientific agriculture. Having thus acquired a knowledge of the terms used, and of the first principles of the science, they would read and study with advantage the many excellent treatises written on this subject by Professor Johnson, Boussingault, Liebig, Stephen, and others. They would hail with delight any new work tending to throw more light on the practice of their art—such as the useful and interesting small book on “Agricultural Physiology,” to which we would beg to direct the attention of our readers.

For a long time, it was the general opinion that Chemistry was the science which could be brought to bear with the greatest effect on the improvement of the practice of agriculture. That this science is indispensable to the scientific agriculturist, no one can reasonably deny; but that it does not exert such an influence on the practice of the art as the pure Chemists would have led him to suppose, appears to be an opinion fast gaining ground—nay, is even rendered apparent by writers on Agricultural Chemistry themselves, who have found it necessary to explain in their works many principles of other sciences, such as Geology and Mineralogy, and, in particular, Animal and Vegetable Physiology.

As there was no separate work, however, on Physiology, intended for the use of the agriculturist, the author of the book before us has undertaken to supply the deficiency, and, in our

opinion, has accomplished his task with great ability, simplicity, and success.

As Chemistry describes the phenomena of *inanimate* matter, so Physiology describes the phenomena of vital beings, or the laws which regulate *vitality* in plants and animals. For example, when we mix sulphuric acid (oil of vitriol) with bone-dust to produce a superphosphate, the actions which take place, and the nature of the new substance produced, are explained by *Chemistry*; and when we feed animals upon turnips—which, among other ingredients, contain saccharine matter and phosphate of lime, and which, therefore, promote the deposition of fat and the growth of bone—the digestion of the turnip, the manner of its absorption into the circulating system, and its deposition as fat and bony structure in the living animal, are all explained by *Physiology*.

Chemistry, therefore, affords us a knowledge of *dead* or inanimate matter, of the composition, not only of soils and manures, but of animals, vegetables, grains, roots, &c.—it cannot do so, however, till they be deprived of life; whereas Physiology affords us a knowledge of the various *living* processes—of the origin, growth, and decay of the animal and vegetable kingdoms of nature, and is one of the most interesting and useful sciences in which the intelligent mind can be engaged.

The book before us is one, the study of which we would beg to recommend, not only to Agriculturists, for whom it is specially intended, but to all who are anxious to add to their stores of intellectual and scientific knowledge; being well assured that, though they may not at once acquiesce in some of the author's deductions, they will read the book as we have done, with a great deal of pleasure, and rise from its attentive perusal with their minds expanded by the acquisition of much new information.

In a brief notice of this sort, we must not even allude to the bulk of interesting and important matter contained in the body of the work, our object being merely to draw the attention of Agriculturists to a few practical points.

After giving a clear and concise view of as much of the first and simple principles of Chemistry and Natural History as are absolutely necessary for the proper understanding of what follows, our author tells us, in describing the "conditions necessary to the continuance of life," that

"All living beings have a nourishing fluid—called sap in Vegetables, blood in animals—which is necessary for the maintenance and increase of their frames. As this nourishing fluid is constantly being used and consumed, it must evidently receive fresh supplies;"—that, "in both animals and vegetables the supply to the nourishing fluid, or the food, must be *soluble* in water, and must always be taken along with water, and subsequently dissolved in it."

By the last part of this quotation, we see the reason why some kinds of manure will act sooner upon a crop than other kinds; and why every kind of manure will act sooner the more rotten or decayed, or the more finely subdivided, it is; so that in applying any manure to a crop we must consider when it will be likely to become soluble in water, as then, and not till then, will it benefit that crop. For example, although it may be necessary in stiff clay soils to apply the farm-yard manure in a rank or undecayed state, for the purpose of keeping the soil sufficiently porous, we must take into account that it will be the longer in exerting its full influence on the crop, just because it will be long before it can become soluble in water; and we must therefore, in order to give the crop a proper start, add some sort of manure which is more soluble. Guano is much more soluble than bone manure, or even than farm-yard

manure, unless perfectly rotten, and it will consequently act sooner on the crop than either of these substances; bone dust will act sooner than crushed bones, and superphosphate sooner than either.

Chapter 4th contains a description of the circulation of the sap in plants, and of the blood in animals. We are told that

“The sap of vegetables receives fresh supplies at the roots; ascends from the root through the stem, to the leaves; here it is exposed to the air, and then it flows through all parts of the plant, for the purpose of promoting its growth.”

We have a beautifully illustrated description of the circulation of the blood in animals, from the simplest, in which, although there is no heart or propelling apparatus, yet the blood circulates, to those of the most complex structure, including man. Here the reader will find much to interest and astonish him, and to exalt his ideas of that Almighty Being, whose “works are wondrous, and his ways past finding out.”

In describing the properties of the principal textures of plants, our author says, in reference to the root, that

“What is usually called the root is nothing more than a subterranean stem, in no ways differing from the stem above ground, excepting that it has no pith. The real root consists of the mass of little tubes or spongioles which grow from the subterranean stem.”

On pulling up any plant or shrub in spring, after the growth has fairly commenced, and examining the root, you will see a number of small, tough, dark brownish looking fibres, which are commonly called roots; from these you will see a great number of white fibres issuing, called spongioles, because they are spongy or porous, although not visibly so to the naked eye; these are the real roots of the plant, they are its *mouths*, if we may so

speak, whereby it absorbs or sucks up its food from the soil. These white roots are very tender and delicate ; and as we have already seen, the food which they absorb from the soil must be dissolved in water, and must be diluted or weakened with water, otherwise their delicate textures would be destroyed by the strength and corroding nature of many kinds of manure. For example, we see that wherever the cattle in the fields drop their urine the grass is much burned or destroyed, if the ground be dry and no rain falling, so that a considerable time elapses before it recovers its former freshness. The reason is, that the liquid manure corrodes or destroys the delicate spongioles or white roots of the grass, and the plants in a manner die till new roots are sent forth.

In chapter 9th, "on the food of plants," which contains much valuable information, we are told, that

"The end of all good cultivation of the soil is twofold—to place plants in such a situation as that they can have perfect health, and to supply them with as much food as they can possibly consume. If either of these be neglected, if the plant be placed in such circumstances as to render it unhealthy, or if it have not a due supply of food, but is starved, then it is impossible that the consummation of the husbandman's wish—a large crop—can be obtained."

If a plant be placed in a proper position to perfect its growth, not only ought the soil to contain a proper quantity of food, but it ought also to be sufficiently porous, to allow the spongy fibres of the root to extend their limits ; to wander about in all directions in search of pasture, as it were ; and this small space ought not to be encroached upon by the roots of the neighbouring plants or weeds ; for if so, they will interfere with one another's share of food, and be all more or less starved. We generally see, however, the soil in which plants are placed either too stiff,

too wet, or too poor, to produce perfect plants ; and the plants themselves are too much crammed together, so that the wonder should not be that a perfect crop is not produced, but, to those acquainted with vegetable physiology, the wonder is that *any* crop can grow.

After many excellent remarks on the formation of soils, and on the ingredients necessary to the composition of a nutritive soil, our author goes on to say that

“If a crop is taken from a perfect soil, such as we have described, that crop takes away a certain portion of these elements, and a certain number of crops takes away them all. The soil then ceases to be a fertile one, and no more crops can be obtained from it.”

If, for instance, a soil contain so much carbon, oxygen, hydrogen, nitrogen, phosphorus, sulphur, and the other inorganic constituents of plants, and a succession of crops be taken from it, each of which abstracts so much carbon, oxygen, hydrogen, nitrogen, phosphorus, sulphur, &c., the result must be, that at last the whole of these ingredients of the soil will have disappeared. If plants are now put into the soil, there is no food for them ; consequently their sap cannot be formed, and they cannot grow or even live. Land in this state is just as we saw it before soils were formed ; and, if left alone, this land can only again become productive by obtaining all these elements in the same manner as at first. The art of the agriculturist, however, can remedy (and prevent) this state of matters, and the soil can be supplied with those elements in which it is deficient.

Food for plants, artificially put into the soil, is called manure. The art of manuring land chiefly depends upon two things :— First a knowledge of the elementary ingredients of the crop intended to be raised ; and, secondly, a knowledge of the constituents of the soil ; or, as our author very correctly expresses it,

“ We must have an exact acquaintance with the constituents of each particular soil, each particular crop, and each particular manure.”

In a brief account of the value and properties of the different kinds of manure, and the various sources of the food of plants, our author, in alluding to the unscientific manner in which farm-yard manure is treated, and the consequent loss, and in remarking that the greater part of the liquid manure is wasted, says

“ That the proper plan is to collect all the liquid manure which is made upon a farm, to store it in tanks; and to fix the ammonia in it by adding a proper quantity of sulphuric acid.”

The value of liquid manure he calculates at £5 per annum for each animal. This valuation is probably too high, but take the lowest calculation, which is £3, and a farmer with 30 head of cattle and horses ought to have £90's worth of liquid manure in a year; four-fifths of this is lost by mismanagement: hence, a loss of £72 per annum—very likely, a sum equal to his whole rent.

Many farmers in this country possess tanks, that is, they have small holes dug which they call tanks, but which will hold only a few weeks' wash; when full, they empty the liquid on the fields at all seasons, and without any preparation whatever; the consequence is, that the effect produced is just what we would suppose—quite trifling; so that, in many cases, their tanks have fallen into disrepute; and, instead of blaming their own ignorance as they ought to do, they blame scientific farming. Had these farmers the least knowledge of agricultural chemistry and physiology, the plan they would adopt would be quite different, and the effect produced would exceed their most sanguine expectations; till then, they should not use tanks at all, but content themselves with spreading their liquid manure upon their

dung heap, or compost heap, if they would only protect these from rain and other water.

“A proper tank ought to be capable of holding all the wash that could be produced in 4 or 5 months; it should be divided into two compartments; when the first is full, the stream should be turned into the second; and by the time this also is full, the first is *ripe* and fit for the land.”

Chemistry tells us that it ought to be applied in a fermenting state. Physiology tells us that you may almost as well empty it into the river, as apply it to porous land in winter, when the spongioles of the plants cannot avail themselves of the supply of food offered to them; by the time they are ready to receive it, it is almost all washed off by the rain, and the ammonia has escaped into the atmosphere. Just as well might we think of feeding a dormouse, while enjoying his winter's repose, as think we can feed plants when the circulation of their sap is almost at the point of stagnation. Again, if the liquid manure is employed unfermented, or undiluted with water, even when plants are growing, it will certainly destroy a great portion of their delicate spongioles and other textures; so that instead of producing immediate advantage, it will check the growth of the plants, and by the time the white roots have recovered themselves, and are ready to absorb food, a considerable portion of the manure is dissipated in the air, or washed away by the rain.

Animals differ from plants in not being fixed to a spot, and receiving continuous supplies of food from without; they are consequently provided with an organ called a stomach, which can contain aliment sufficient to last them for some time, and from which they gradually draw their supply of nourishment.

“In herbivorous animals—such as cattle and sheep—the unmasticated food passes into the first stomach or paunch. It is mixed here with a fluid, and then transmitted into the second stomach or honey-comb. Fluid, how-

ever, passes directly into the honey-comb without entering the paunch. From this honey-comb, the food is transmitted back again into the mouth, and there masticated. It is again swallowed and transmitted into the third stomach or manyplies; and from this again it passes into the fourth stomach or reed, where the gastric juice is applied to it.—(See Figs. 17, 24, and 25.)”

The gastric juice converts the food into a greyish pulpy mass called *chyme*; this chyme is propelled by degrees through the intestines, where it is mixed with the bile, the pancreatic juice, and mucous. In the intestines the chyme gradually separates into a milky-like fluid called *chyle*, and dung. The chyle is the nutritive portion of the food, and is taken up or absorbed by small vessels called *lacteals*, and added to the blood, which, as before remarked, is the nourishing fluid of animals—analogueous to sap in vegetables—and is “necessary for the increase and maintenance of their frames.”

We are farther told that “this nourishing fluid must and does contain all the elements of which the structure of the individual plant or animal is composed;” hence it follows that the food of plants and the food of animals, from which their nourishing fluids draw their supplies, must also contain all these elements. As an example in plants, we know, by chemical analysis, that wheat, barley, and oats contain, among other ingredients, a quantity of a substance called *silica*; that turnips contain *phosphate of lime*; and that beet-root contains *magnesia*; we therefore infer, that a soil destitute of silica can neither grow wheat, barley, nor oats; that a soil destitute of phosphoric acid and lime cannot grow turnips; and that a soil destitute of magnesia cannot grow beet-root, and so forth. In the same way, as already mentioned, the food of animals must contain the ingredients necessary for supplying their nourishing fluid or their blood, with

the means of building up and maintaining their separate structures—bone, flesh, fat, &c. And, as the structures of animals may be naturally arranged into three sections,—the Oleaginous or oily, the Saccharine or sugary, the Albuminous or fleshy—it therefore follows, that in order to keep an animal in proper condition, to feed it, or make it grow, we must supply it daily with a sufficient quantity of Oleaginous, Saccharine, and Albuminous articles of food; besides the necessary inorganic constituents, phosphorus, sulphur, lime, &c.

“However, we have seen that these are associated in vegetables with the saccharine, oily, and albuminous principles; in case, however, any particular crop may be deficient in a due supply of these, it is always a prudent thing for the feeder of stock to give a mixed diet.”

We can now understand why the food must be adapted, both as to quantity and quality, for the different purposes it is intended to serve in the animal body. And how admirably is this rule followed by nature! She provides a sufficiency of milk, and intends it as the sole food of all mammiferous animals for a certain period of their existence; and milk contains a rich supply of all the ingredients required for the growth of the body—the saccharine, the oily, and the albuminous; as well as the inorganic elements, such as the phosphate of lime for the growth of the bones, &c. Nothing then but ignorance of the principles of physiology could make any one skim off the oily portion—or the cream—from the milk he gives his children or his calves, and thus deprive them of one of the essential elements of their bodily structures.

The nutritive portion of the food has two distinct purposes to serve in the body, after the animal has arrived at maturity or is full grown; and three, before this period. First, to compensate for the daily waste; secondly, to produce animal heat; and, in the growing animal, thirdly, to promote its growth.

Although imperceptibly to our senses, the body is continually undergoing a process of renovation; and our flesh, and bones, and blood are by no means the same as we possessed a few years back. The different particles of which the animal body is composed, and which have been deposited from the blood to build up the living structure, having accomplished the offices assigned them, again enter the circulation, and are thrown out of the body at its various orifices. These effete particles are called *excretions*. Independently of what passes from the bowels and bladder, as feces and urine, there are about 15 ounces of vapour (composed chiefly of carbonic acid and water,) thrown off from the lungs of a full grown man every day; and about 30 ounces of other matters from the skin, as insensible perspiration. We can easily infer from these facts, that unless sufficient food be taken to compensate for this waste, the body must diminish in bulk; and in disease or famine, when the necessary supply of food is cut off, we see that the body does rapidly diminish in bulk and weight. There are two things which are very important to be remembered in connection with this subject: that to keep the body in a healthy state, all these excretions must be thrown off to a *natural* extent; and that they are increased by *exercise*. The solid matters in the urine, the exhalation from the lungs, the perspiration from the skin, are all increased in proportion to the amount of exercise taken; more food is accordingly required to supply the extra waste.

The second purpose served by the food is to keep up the animal heat. And, as it requires the same ingredient in the food—called the *carbon* of the food by chemists—to perform this office as it does to produce fat, we can therefore see that the warmer and more comfortable an animal is kept, the less of this carbon will be required to keep up the heat of the body, and the

more will go to produce fat. It must also be borne in mind, that if an animal is not supplied with the quality and quantity of food necessary to keep up this vital heat, if much exercise be allowed, or if it be exposed to wet and cold, the fat it has already accumulated is absorbed and consumed to compensate for the want, or the additional waste of the carbon of its food. Thus carnivorous animals, that take a great amount of exercise, are almost destitute of fat, the carbon of their food being used or expended as fast as it is taken into the system; while the lazy indolent ox deposits in abundance his superfluous carbon in the shape of fat. All travellers tell us, that in warm climates cattle get *fat* upon food which would barely keep them in existence here; even in a warm summer in this country the cattle keep in better condition than the burnt-up and miserable state of the pastures would lead us to suppose possible; the reason is, that little of their food being required to produce heat, the greater part of it goes to feed and nourish the body.

The third office which the food has to perform, in addition to the two already mentioned, is, in growing animals, to increase the bulk of the body; and in fattening animals to produce fat. From this we learn, that a young growing animal requires more food in proportion to its size than one full grown, and a fattening animal, than one we are not fattening.

In the fattening of animals not only must we keep all the above considerations in view—supply them with food sufficient to compensate for the daily waste; allow them little exercise; and keep them warm—but we will also find it advantageous to give them a certain extra quantity of oleaginous food, such as oil-cake, to be deposited in the different parts of the body as fat. As, however, the value of oil-cake for fattening chiefly depends on the proportion of oil it contains; and as the manufacturers

are getting daily better acquainted with, and adopting more effectual means of, extracting this oil, it becomes a matter seriously to be considered, whether farmers should not grow flax, and feed with their own linseed.

In the chapter "on sleep," we are told that, "it seems to be a fact that much sleeping favours the deposition of fat." And as we know that "sleep is promoted by darkness, mental tranquillity, an agreeable temperature, by silence, and the absence of all lively impressions," it follows that these conditions ought also to be strictly attended to in the feeding of animals.

We must likewise attend to the health of the animals; of course

"An ox in a state of ill health does not secrete so much fat as a healthy animal would do. Hence it is of importance to consider if our domestic animals are often exposed to the influence of slowly-acting poisons; and we find that there are two such—the emanations from decaying animal matter, and carbonic acid gas. The first of these collects in a stable or cow-house that is not well drained and washed. The second, we have seen, is excreted from the lungs of animals every time that they respire; and unless the house in which they live is well ventilated, the air in it will become heavily charged with carbonic acid, which will exercise a very prejudicial effect upon the inmates."

We have now glanced at a few of the most important considerations which bear upon the feeding of animals scientifically, and we need scarcely draw the attention of our readers to the great difference between this and the plan generally adopted. Instead of being kept warm, they are exposed to the changing temperature of our ever-changing climate; at one time tormented and driven to over-exercise by the flies; at another time deprived of a great portion of their animal heat, by the rain and the cold dews. Instead of having a proper mixture of the dif-

ferent kinds of food in winter, they are gorged with turnips, two-thirds of the nutriment of which pass off by the bowels, from the looseness this extra quantity of one kind of food occasions. Instead of breathing a pure air, the stench of the effluvia from the dung, their confined breath from bad ventilation, and the exhalations from the putrid remains of turnips and the saliva in their stalls, *all* render it wonderful that the animals keep in health and fatten as they do; although it is certain, that, by these drawbacks, the *time* they take to fatten is very much prolonged.

In the small space to which we must at present confine our remarks, on a subject which would require volumes to explain and illustrate, we have scarcely done more than sketch a rough outline of the path to be pursued by every one who aspires to the name of a "scientific agriculturist," or who wishes to practise his art with satisfaction and profit to himself, and with advantage to the community. To guide him in his labours in acquiring a knowledge of the subject, by far the most efficient means would be a proper teacher, by whose instruction the book before us could be turned to much more account; but even in the absence of such an advantage, we would beg to recommend this treatise to the careful perusal of all interested in the science. It is illustrated by a series of admirable plates, and its clear arrangement, entertaining style, and vast amount of useful matter contained in small bulk, cannot fail to prove a boon to the student of agriculture.

