GEORGICK PAPERS

FOR

1809,

CONSISTING OF

LETTERS AND EXTRACTS,

COMMUNICATED TO THE

MASSACHUSETTS SOCIETY

FOR

PROMOTING

AGRICULTURE.

Published by the Trustees.

Without encouragement of Agriculture, and thereby increasing the number of its people, any country, however blessed by nature, must continue poor.

SWIFT.

BOSTON,

PRINTED BY RUSSELL AND CUTLER

1809

CONTENTS.

Preface - - - - - - - - - - - - - - - - - 5
Premiums - - - - - - - - - - - - - - - - - 7
Address of the Kennebec Agricultural Society - - - 9
Prejudice against the Berberry Shrub - - - - - - - 14
Of Curculio, a genus of Insects - - - - - - - - 15
History of the Merino Sheep - - - - - - - - - - 19
Use of Salt for cattle, and the preservation of hay - - 24
Utility of painting garden fences black - - - - - - - 25
Advice to Dairy Women - - - - - - - - - - 26
Boiling grain for horses - - - - - - - - - - - 27
Useful and ingenious Calculations - - - - - - - 27
Propagation and culture of the common Parsnep - - 29
Sap of Plants - - - - - - - - - - - - - - - 32
Functions of the Leaves during the day - - - - - 42
Functions of the Leaves during the night - - - - 49
Peculiar Juices of Plants - - - - - - - - - - - 51
Decay of Plants - - - - - - - - - - - - - - 56
Decomposition of Vegetable Substances - - - - - 58
Col. Humphreys' Letter to Dr. Dexter - - - - - - 59
Col. Humphreys' Letter to Mr. Tyng - - - - - - 61
Management of the Dairy - - - - - - - - - - - 63
Course of work by Gardeners - - - - - - - - - - 74
Art of destroying Moles - - - - - - - - - - - 81

OFFICERS OF THE SOCIETY,

CHOSEN JUNE 1808.

PREFACE.

ALTHOUGH in their papers for 1809 the Trustees of the Massachusetts Society for promoting Agriculture are unable to number many original communications, they, however, hope that their selections will be found adapted to the design of the Institution.

The intimate connection subsisting between chemical knowledge and improvements in husbandry is well known to intelligent farmers, and is an obvious reason for devoting many of the following pages to an extract on the nature of vegetables. By knowing the operation of different substances upon each other, we learn what is the proper food of plants, and, of course, how most successfully to cherish their growth.

The art of improving and managing breeds of cattle and sheep begins to exercise the attention of wealthy and patriotick landholders, who thus give promise of serving at once the agriculture and manufactures of the nation. In this view, lord Somerville's memoir to the Bath Society, and the elegant letters of Col. Humphreys, on the habits and excellence of the Merino Sheep, will be no less interesting to the American Publick, than they are creditable to their authors. The disposition of the Trustees, also, to encourage the propagation of the Merinos in this country will be seen by the premiums which they offer to importers.

The naturalist will be amused, perhaps instructed, by the history of the Curculio and of the Mole. The tract on the latter is a translation from an ingenious French writer ; and though the depredations of this animal are not the subject of general complaint in this part of the country, yet it is elsewhere troublesome and destructive.

The badness of the butter, usually marketed in this vicinity, frequently excites disgust and murmurs. In the hope of doing somewhat towards remedying the evil, the Trustees have this year republished a paper, which they published in 1793, containing Dr. Anderson's aphorisms on the management of a dairy.

The extract from Mawe is made for the benefit of those who are destitute of the work itself, and of the still more useful treatise on the same subject by M'Mahon : but the

American gardener must recollect, that the difference between the seasons here and in England is considerable.

The valuable communication from Kennebec, and several miscellaneous articles, entitle the gentlemen who furnished them to the thanks of the publick.

The Trustees, in superintending the concerns of the Society, have no objects in view other than those which should inspire a deep and common interest, the immediate improvement of husbandry, the relative advancement of the arts, and the ultimate prosperity of the country. As it was the original design of their Association, so it is still their desire and purpose to encourage by suitable premiums an attention to agricultural pursuits; to throw into the publick stock the knowledge of such useful improvements as they may severally possess; and to procure models of approved machines to be examined and imitated. It is evident, however, that these objects cannot be completely attained without farther legislative aid, than they already enjoy, and a spirit of more liberal inquiry and communication among practical farmers, than has yet been manifested. On the last article, particularly, therefore, they beg leave most earnestly to repeat a request, which they formerly made, that farmers in the interior and distant parts of the Commonwealth would favour them with original communications. It is by no means necessary that a man, profitably to write for this work, should be intimately acquainted with the structure and character of plants, or with the modes of farming in foreign countries, or with the ornaments of style, or with even the rules of grammar. Plain facts in plain language; journals of labour performed, and of the time and manner of sowing the same seeds in different grounds; and hints on probable improvements in the tillage of old farms, and the subduing of new ones—will ever be acceptable to the Trustees, who, to the best of their power, will methodize such facts and observations, and publish them for the general benefit.

BOSTON, MAY 24, 1809.

PREMIUMS

OFFERED BY THE TRUSTEES OF THE MASSACHUSETTS SOCIETY FOR PROMOTING AGRICULTURE.

....

1st. TO the person who shall discover an effectual and cheap method of destroying the Canker-worm, and give evidence thereof, to the satisfaction of the trustees, on or before the first day of June, 1811, a premium of *one hundred dollars*, or the society's gold medal.

2d. And a premium of *one hundred dollars*, or the society's gold medal, to the person who shall, on or before the first day of October, 1811, discover an effectual, and the cheapest method of destroying the Slug-worm, and give evidence thereof to the satisfaction of the trustees.

3d. To the person who shall produce the largest quantity of wool, meat and tallow, from the smallest number of sheep, not less than ten, raised on his own farm, a premium of *thirty dollars*; to be claimed on or before the 1st day of August, 1811.

4th. To the person who shall invent a cheap method of raising water, for the purpose of irrigating land from rivers and ponds from ten to twenty feet above the level of the same, and give evidence thereof to the satisfaction of the trustees, on or before January 1, 1811, *one hundred dollars*, or the society's gold medal.

5th. To the person who shall present to this society the most complete (being nearly complete) Hortus Siccus, exhibiting distinct specimens of the greatest variety of grasses, in general use, and specify, to the satisfaction of the trustees, their respective qualities, productiveness and usefulness as food for different kinds of animals, the gold medal, and *fifty dollars*; to be claimed on or before the 1st day of October, 1812.

6th. To the person who shall produce, from seed, the best growth of thrifty trees, not less than 600 in the whole, and in the proportion of 2400 to the acre. of any of the following kinds of forest trees, viz. oak, ash, elm, sugar maple, beech, black or yellow birch, chestnut, walnut or hickory, *twenty-five dollars*; if all of oak, *fifty dollars*. Claims to be made on or before the 1st of October, 1812.

7th. To the person who shall ascertain by accurate analysis, the constituent parts of several fertile soils respectively, and in like manner the parts of several poor soils, and thus shall discover the defects of the latter; and shall show by actual experiments how the said defects may be remedied by the addition of earths or other ingredients, which abound in the country, and in a manner that may be practised by common farmers, *fifty dollars*. And if it shall appear to the satisfaction of the trustees, that, upon an extensive practice, the improvement of the poor soil would be more than equivalent to the expense of the improvement, the addition of *one hundred dollars*. A minute description of the several soils, and all the circumstances attending the processes, cultivation, and results, will be required. Claims to be made on or before November 1, 1813.

8th. To the person who shall, by actual experiment, on a quantity not less than half a ton, shew the best method of curing clover hay with salt; regard to be had to the quality of the hay, and the saving of labour, and the shortness of time between cutting and packing it in the mow, the silver medal, or *thirty dollars*: and to the person who shall shew the next best method, *twenty dollars*. Samples of the hay to be exhibited, three months after it is cured, to a majority of the selectmen, or to the settled minister and justice of the peace in the vicinity. Claims to be made on or before the last Friday of November, 1811.

9th. To the person who shall give the most satisfactory account, verified by experiments, of the effect of ploughing in green crops for manure, on not less than two acres, the silver medal, or *thirty dollars*. Accounts with certificates, to be produced on or before the first Tuesday in March, 1811.

10th. To the person who shall lay before the Board, the most satisfactory account of the application and effect of manures, verified by practical experiments, on not less than one acre for each sort of manure, the silver medal, or *thirty dollars*. To be produced on or before the first Tuesday in December, 1810.

11th. To the person or persons who shall import into this Commonwealth, directly from the kingdom of Spain, the first five rams of the Merino breed, the sum of fifty dollars each; and for the first ten ewes of the same breed, the sum of twenty-five dollars each, as a bounty on such importation.

The person or persons claiming this last premium, or any portion of it, must produce satisfactory evidence to the trustees, that the rams and ewes for which the premium is claimed, have been bona fide sold to farmers, citizens of this Commonwealth, and that no more than one ram and two ewes have been sold to the same person.

12th. It is required that the communications, for which the foregoing premiums are offered, be accompanied with proper certificates from the selectmen, magistrates, or clergymen of the vicinity, or other vouchers, to the satisfaction of the trustees; that they be delivered in without names, or any intimation to whom they belong; and that they be severally marked in such manner as each claimant shall think fit; the claimant sending also a paper, sealed up, having on the outside a corresponding mark, and on the inside his name and address.

By Order of the Trustees,

DUDLEY A. TYNG, *Secretary*.

AGRICULTURE.

To the Trustees of the Agricultural Society.

GENTLEMEN,

THE following Communication appeared in the Kennebec Gazette, for June 19 and 26, of 1807, which you will do a favour to the farmers of Massachusetts to republish in your Agricultural papers.

Yours, &c. B. V.

November, 1807.

To the Farmers of Kennebec.

THE Kennebec Agricultural Society has been pleased to appoint us as a Committee for addressing the farmers of these parts on the general subject of agriculture. Though different engagements have hitherto prevented our attending to these instructions, the present state of our grass, and the emptiness of our barns, induce us to speak without delay of *two particulars* of much importance at this moment.

The first is, how to *increase* the food of our cattle through the ensuing winter and spring; and the second, how to *use* that food with most economy.

For *increasing* the food, the following measures seem adviseable. First, to sow as many oats as possible, to be cut in the milk. Next, to add to our plantations of corn, chiefly with a view to fodder, whether the ear ripen or not. If other land does not offer, some grass land had better be broken up; the rotten turf of which will serve as manure. To quicken the growth and add to the vigour of the corn, the seed may be soaked in water, which is not only warm, but somewhat hot, when poured upon it; and in which cow-dung has also been mixed. When taken out for sowing, the seed may be rolled in

Plaster of Paris; and a table-spoonful of plaster may be strewed on the surface of the ground next to the plants, at the first and second hoeing. Ashes may be used in the absence of plaster, but in larger quantities. If manure can be spared for the holes, it will of course be of much service. Thirdly, potatoes, carrots, and some other vegetables, which may serve instead of hay, as also beans for sheep, may still be raised in great quantities; but above all, *turnips* are to be recommended. Should seed be wanting for these objects, barley and wheat, though less profitable, may be sown, to be cut either in the milk, or instantly on the slightest sign of rust. Pumkins (pompions) would be of great consequence, as being among the most fattening food used for cattle; but it is feared that they will not now perfectly ripen; though when they have reached their full size, they will still be serviceable in their green state. A resource is next to be mentioned, which is open to all; namely, the *gathering* of leaves, in a dry hot day in autumn, from all trees which drop their leaves; the oak perhaps excepted. After exposing these leaves during a few hours to the sun, they are to be packed as closely as possible on every side, to keep them from air and moisture; and when opened for use, they must be shut again as soon as possible. Those who have boards at command may throw in some of them loosely, at certain depths, to form the leaves into layers, and add to their protection. Some preserve not only leaves, but the connected twigs where they are small enough to be eaten; which is a saving both of fodder and time. This kind of fodder may be got from trees intended for cord-wood, or from boughs and underwood. The help of children will render this fodder cheaper than hay in dear seasons; though it is not likely that it will be used in common years, unless on new farms; and there it may be kept in pits, if barns are wanting. The experience of 2000 years speaks in favour of this fodder in various parts of Italy; nor is it despised in France and other countries.*

These measures are recommended before the winter commences. During the winter, and especially towards spring, the cattle may be made to *browse* on various hard-wood trees, and on hemlocks, cut down for other purposes, and to which paths must be made through the snow. This diet may be helped out with salt, with the occasional addition of fodder, and serve for store-cattle. Indian corn, and still more its meal, will go far in the support of working cattle and horses; and if it be held twice as nourishing as hay (weight for weight,) twenty bushels of Indian corn, at a dollar each, will go as far as a ton of hay at twenty dollars; and be moved with more ease, and as little waste. When the *leaves appear,* the cattle may be turned into such woods as are designed to be cut down; and these woods may be fenced in a slight manner for future use, where they are convenient and sufficiently watered.

As to the *second object* of this address, the *economical application* of what is provided for cattle; it may be obtained in several ways. All hard seeds, as Indian corn, oats, and barley, will be far more nourishing, if soaked in water, or otherwise prepared for ready digestion by grinding, baking, or boiling. The mere act of *grinding* not only cracks the shell, but *multiplies the surfaces* of these seeds; so that the juices of the stomach, &c. easily penetrate to every part, in order to digest them fully and quickly. Thus, take a cube with its six surfaces, and separate it into two parts in a direction parallel with any two of its sides; and we add two

* See YOUNG's Annals of Agriculture, vol. 1, p. 207, and vol. 4, p. 61.

more sides equal to either of the six; and any new and similar separation will do the same. But the coarse grinding of Indian corn will not at all times, secure a complete digestion, where too much is given, either at a time, or through the day; as may be seen from undigested pieces remaining in the dung of cattle thus fed; though the waste is out of all proportion greater, where Indian corn is given whole. We learn from public authority, that by *soaking* oats for twenty-four hours, the French cavalry have had their horses supported with only two thirds of their common allowance.* Potatoes also are more nourishing, if boiled or baked. As many animals are dainty (especially full grown oxen which have been well kept) it must be the express business of some one to accustom them all respectively to their new diets. The water left from steeping or boiling their food, if not relished by the larger animals, will serve for the pig-stye. In general all offals, as the tops of turnips and carrots, and straw, must be saved for use; and the lower ends of corn stalks must be cut down, sliced, and scalded for cattle, as in Pennsylvania. The chopping of straw is important, as it renders the straw easy to be managed and chewed by the cattle; but simpler methods of chopping it, than any yet known, require to be pointed out. But for making food in general nourishing, it must be given by little at a time; for, as digestion is carried on principally by means of juices, the smaller the meal is, the more easily will it be supplied with and surrounded by these juices. As warmth has its share in promoting digestion, cattle are found to require less food, when sheltered from our severe colds It is said that the native cavalry in India keep their horses at much

* See YOUNG, as above, vol. 4, p. 66, as evidence for the chief of this assertion.

less expense than the British cavalry there, in consequence of constant rubbing applied to their coats.

The following fact may perhaps turn the public attention to the subject of fodder in an efficacious and permanent manner. Hay in the seaport towns in the United States is constantly much dearer than hay is in London, the capital city of a luxurious nation, overloaded with public debt and possessing but a comparatively small territory: and it is now dearer even in the county of Kennebec. This seems chiefly owing to the English farmer being in the habit of keeping the surplus hay of plentiful years to assist in the supply of scarce years; his hay being sometimes three and even four years old; and being always acknowledged to be a heartier food in the second year, than in the first. There are many barns in use in England for keeping hay; but *hay stacks* of immense size are much more frequent covered with straw thatching; the art of making which is easily learned, and when well learned would answer in this country. From these stacks the hay is cut out in narrow columns, from top to bottom, with a simple knife, easily made and easily managed. If the Kennebec farmer will not learn the art of thatching in the European manner, he may keep his surplus hay in a barn consisting of a roof and sides till he can finish it within to his wishes. But a barn designed for hay only, and not for cattle, can want nothing beyond; unless it be a floor, to avoid waste, moisture, air, dirt, and vermin.

That new measures are required in a country, which boasts of its soil and abundance of land, is plain, from the repeated scarcities lately occurring in our food for horses and cattle, to say nothing of that for man. Every good farmer and good patriot, and every benevolent man, will, therefore, acknowledge the necessity of attending to such measures; whether we consult the services, the fatness, the growth, the look, the health, the comfort, and even the life of the dumb animals committed to our care, and on whose prosperity our own so much depends. The *store-keeper* is scarcely less interested on this occasion than the farmer; for if the farmer succeeds no better than last year, he will pay no better; and two or three bad years together will injure the credit of both.

In the name and by order of the Committee,

JOHN MERRICK.

Note.—The weather and other circumstances took a turn so favourable, subsequent to the month of June last, when the above was written, that particular exertions to remedy scarcity no longer became necessary in the quarter of the country in question.

To the Trustees of the Agricultural Society.

Gentlemen,

THE following extract from "Miller's Gardener's Dictionary" is somewhat opposed to the opinion generally holden as to the effect of the common Berberry upon grain, and at the same time so plausible, that I have thought it worth publication. Though it does not establish the fact, that the Berberry emits no noxious influence, yet it may serve to remove a prejudice of our farmers, and be the means of preserving a salutary shrub, which is often, for no good reason, devoted to destruction. By making it known, therefore, through the medium of your work, you may benefit society, and will oblige

Yours, &c. R.

Cambridge, April, 1809.

- - - - - - - -

THIS shrub has lately acquired an ill name for a very mischievous effect, which, if true, should induce every husbandman to extirpate it from the vicinity of his corn lands. It is affirmed, that ears of wheat, which grow near it, never fill, and that its influence in this respect has been known to extend three or four hundred yards.*

Mr. Macro, a very respectable farmer at Barrow, in Suffolk, planted a Berberry bush in his garden, on purpose to ascertain the fact. He set wheat round it three succeeding years, and it was all so completely mildewed, that the best of the little grain it produced, was only about the size of their rice, and that without any flower. He adds, that some which he set on the opposite side of his garden, one of the years, produced very good grain, although the straw was a little mildewed.† There are other accounts from practical men, corresponding with this of Mr. Macro's. We can scarcely, however yield our assent to an appearance so strange and so wholly unaccountable, till the fact has been examined more accurately. The Berberry is so common in the hedges about Saffron Walden, in Essex, and many miles round that place, where corn grows frequently up to the very hedge, that we can scarcely suppose such an interesting effect to have escaped observation. The celebrated Duhamel long since looked upon the mildewing power of the Berberry, as totally void of foundation; and Mons. Broussonet, who has bent his attention particularly to Agriculture, assures us of the same thing from his own observations.‡

Extract from a communication, by Doctor James Tilton, of Wilmington, Delaware, on the subject of an Insect, so generally destructive to the choice fruits of our country; and published in the first American edition of the Domestic Encyclopedia, in Philadelphia.

Curculio, a genus of insects belonging to the

* Withering. † Young's Annals. 7. 188. ‡ English Botany. 49

Coleoptera or *Beetle* order: the species are said to be very numerous: the immense *damage done* by an insect of this tribe to the fruits of this country, of which there is no similar account in Europe, has given rise to a conjecture with some naturalists, that we have a peculiar and very destructive species in America.

The manner, in which this insect injures and destroys our fruits, is, by its mode of propagation. Early in the spring, about the time when the fruit trees are in blossom, the *Curculiones* ascend in swarms from the earth, crawl up the trees, and as the several fruits advance, they puncture the rind or skin, with their pointed rostra, and deposite their embryos in the wounds thus inflicted. The maggot, thus bedded in the fruit, preys upon its pulp and juices, until, in most instances, the fruit perishes, falls to the ground, and the insect, escaping from so unsafe a residence, makes a sure retreat into the earth; where, like other Beetles, it remains in the form of a grub, or worm, during the winter, ready to be metamorphosed into a bug, or beetle, as the spring advances. Thus every tree furnishes its own enemy; for although these bugs have manifestly the capacity of flying, they appear very reluctant in the use of their wings; and perhaps never employ them, but when necessity compels them to migrate. It is a fact, that two trees of the same kind may stand in the nearest possible neighbourhood, not to touch each other, and that one will have its fruit destroyed by the Curculio, and the other be uninjured, merely from contingent circumstances, which prevent the insects from crawling up the one, whilst they are uninterrupted from climbing the other.

The Curculio delights most in the smooth skinned stone fruits, such as nectarines, plumbs, apricots, &c. when they abound on a farm; they nevertheless attack the rough skinned peach, the apple, pear, and quince. The instinctive sagacity of these creatures directs them especially to the fruits most adapted to their purpose. The stone fruits more certainly perish by the wounds made by these insects, so as to fall in due time to the ground, and afford an opportunity to the young maggot to hide itself in the earth. Although multitudes of these fruits fall, yet many recover from their wounds, which heal up with deeply indented scars. This probably disconcerts the Curculio in its intended course to the earth. Be this as it may, certain it is, that pears are less liable to fall, and are less injured by this insect than apples. Nectarines, plumbs, &c. in most districts of our country, where the Curculio has gained an establishment, are utterly destroyed, unless special means are employed for their preservation. Cherries escape better on account of their rapid progress to maturity and their abundant crops: the Curculio can only puncture a small part of them during the short time they hang upon the tree. These destructive insects continue their depredations from the first of May until autumn. Our fruits, collectively estimated, must thereby be depreciated more than half their value.

It is supposed that the Curculio is not only injurious above ground, but also in its retreat, below the surface of the earth, by preying on the roots of our fruit trees. We know that Beetles have, in some instances, abounded in such a manner as to endanger whole forests. Our fruit trees often die, from manifest injuries done to the roots by insects, and by no insects more probably than the Curculio. In districts where this insect abounds, cherry trees and apple trees, which disconcert it most above, appear to be the special objects of its vengeance below the surface of the earth.

These are serious evils, to combat which every scientific inquirer is loudly called upon to exert his talents; every industrious farmer to double his diligence; and all benevolent characters to contribute their mite.

Naturalists have been accustomed to destroy vicious insects by employing their natural enemies to devour them.

We are unacquainted with any tribe of insects able to destroy the Curculio. All the domestic animals, however, if well directed, contribute to this purpose. Hogs, in a special manner, are qualified for the work of extermination. This voracious animal, if suffered to go at large in orchards, and among fruit trees, devours all the fruit that falls, and among others the Curculiones, in the maggot state, which may be contained in them. Being thus generally destroyed in the embryo state, there will b few or no bugs to ascend from the earth in th spring to injure the fruit. Many experienced far mers have noted the advantage of hogs running i their orchards. Mr Bordley, in his excellen "*Essays on Husbandry,*" takes particular notice c the great advantage of hogs to orchards: and a though he attributes the benefits derived from thes animals to the excellence of their manure, and thei occasional rooting about the trees, his mistake i this trivial circumstance does by no means inval date the general remarks of this acute observe The fact is, hogs render fruits of all kinds fair an unblemished by destroying the Curculio.

The ordinary fowls of a farm yard are great d vourers of Beetles. Poultry in general are regar ed as carnivorous in summer, and therefore coop sometimes before they are eaten. Every body kno with what avidity ducks seize on the tumble bu (*scarabæus carnifex*) and it is probable the Curc lio is regarded by all the fowls as an equally delicious morsel. Therefore it is, that the smooth stone fruits particularly succeed much better in lanes and yards, where the poultry run without restraint, than in gardens and other enclosures, where the fowls are excluded.

The following history of Merino Sheep is taken from Lord SOMERVILLE'*s Memoir, addressed to the Bath Society in* 1802; *containing also some important observations on the use of salt for cattle, and the preservation of hay.*

I RECEIVED from Mr. LASTEYRIE, together with a most polite letter, his history of the introduction of Merino sheep into different parts of Europe, lately published. His exertions in tracing the different properties of sheep in Spain, Sweden, Denmark, Saxony, Prussia, &c. &c. are unexampled; his knowledge has obviously been obtained in the sheepfold, and the fluency and correctness, with which he details the various diseases of sheep, and their remedies, declare him to possess a shepherd's knowledge of a flock. In his commencement of the subject, he expresses himself thus:

"The different governments of Europe had long acknowledged the advantages, that would be derived to agriculture and commerce from the introduction of fine wools into their respective states; but their views meeting opposition in the ignorance and prejudice of the times, a considerable number of years elapsed before they set about realizing an idea, which at first seemed chimerical; at length there appeared men, equally commendable for their patriotism and their knowledge, who have laboured, with zeal and perseverance, to enlighten their fellow-citizens, by producing facts to prove, that nature, far from opposing itself to the preservation of fine-wool sheep in certain climates, seemed, on the contrary, to lend itself complacently to the exertions of industry. I believe I have demonstrated in my treatise on sheep, that the fine wools of Spain depend neither on the voyage, nor on the soil, nor the climate, nor the pasture, but that they depend on other causes, and that it is possible to have in France and elsewhere, wool of the same quality as that of Spain. My travels in the north of Europe have offered facts and observations, which have afresh demonstrated this truth. I have found, in the far greater number of the flocks I have examined, wool, which, judging from the eye or the touch, equals in beauty and fineness that of Segovia and Leon; so much so, that in my opinion no doubt can remain, that we can obtain superfine fleeces in every part of Europe, where pastures are to be found, and where we can depend on winter food, on which sheep can be supported. These wools make cloths as fine, as silky, and supple, as those manufactured of Spanish wool, as attempts made in France, and other countries, prove. But were it true, that the food, climate, and other local circumstances had a certain influence on the intrinsic qualities of wool, such as the elasticity, the strength, the softness, &c. &c. it would not be the less proved, that, at all events, cloths, fine and beautiful enough to satisfy persons the most difficult on this point, can be obtained; and that a nation can easily do without the fine wools of Spain, and feed its finest manufactures with those drawn from its own proper soil. Nevertheless, as these truths are still held in doubt by some persons, and lest these doubts should have a considerable influence on our agriculture and our commerce, I thought it my duty to publish these facts, which must give a new degree of force and certainty. I here present to view the actual state of Merino flocks, naturalized in Europe."

He says, that a Merino flock came into Sweden, in 1723; that from the year 1740, to the year 1780, a bounty of seventy-five per cent. was allowed to those, who sold fine wool; in 1780, these bounties were reduced to 15, and in 1786, to 12 per cent.; and in 1792, being no longer deemed necessary to encourage this breed, they ceased. In 1764, Sweden possessed 65,369 Merino sheep of the pure blood, and 23,384 of the mixed blood: since that period they have constantly increased in number, in spite of the difficulty occasioned by the length of winter, and severity of the climate. That the Merino sheep preserve, in Sweden, their pristine form; that the fleeces have lost nothing of their equality of length, their elasticity, and their fine quality of pile; that their weight continues as great as in Spain; that he has seen Merino rams, whose fleeces weigh 13 pounds each; and that, when seasoned to the climate, and properly fed, he has seen them larger and finer sheep than in Spain. Upper Saxony, he says, is the country next to Sweden, where the introduction of the Merino is of the longest date; and it is in Saxony where this naturalization has met with the most marked success, and produced effects the most beneficial: the native breeds have, by a mixture of Merino blood, profited in an equal degree. The first importation was in 1765; the next in 1778. Mr. LASTEYRIE says, he has seen many different flocks, and has found the pure Merino, as well as some mixed breeds, producing wool of the first quality; indeed, the sheepwalks of Saxony are at this moment more productive than any other species of husbandry; and the wool sells at three times the price of the wools of the country. Saxony rears about 1,600,000 sheep, of which 90,000 are Merinos, and the mixed bre d.

They were introduced into Prussia by FREDERICK II. in the year 1786. Some of these, distributed over the country, from mismanagement and gross neglect, have degenerated and died; others he has seen which preserve their pristine qualities

In Denmark, and in various parts of Germany, Mr. LASTEYRIE has seen this race of sheep always prospering, if well treated; and in this, and every other country, degenerating from want of food, and neglect; always, however, doing as well as the native breeds in the same keep, and in some cases better; that the more regular and ample the supply of food is, whether of grass or green vegetables, the heavier and finer will be the fleece—the larger in size and more perfect in shape will the sheep be. He strongly recommends housing; but adds that foul, close, sheepcots are injurious; that a free circulation of air is always found beneficial, and that this breed of sheep suffers more from heat than from cold—(this doctrine has been repeatedly confirmed by our practice at home;) that they will get fat as quick as any indigenous breed, in any country, and have done so wherever a comparison has been made.

An experiment was made on the Merino sheep of Rambouillet, which denotes the peculiar character of this breed, and its tendency to carry wool. A ewe, eighteen months old, was left unshorn; the next season, her fleece, when shorn, weighed fourteen pounds ten ounces; and its pile, which was double the usual length, lost nothing as to weight, because few ewes would have given more wool, if clipped at the usual period. Another ewe was shorn at thirty months old, and gave a still greater quantity of wool, although she, at that season suckled a lamb ; her fleece weighed twenty-one pounds, and the pile was eight inches long. In the ninth year (1800) eight ewes, whose fleeces were of two years' growth, gave from sixteen to twenty pounds each It appeared from these different experiments, that Merino wool of two years growth will double its length, and will preserve all its fine quality. It was not observed, that the sheep, subjected to this experiment, suffered particularly from heat, or that their health was in any degree injured. It is possible, that this property in the Merino fleece to grow beyond the period usual in our breed of sheep, may be productive of some new manufacture, where great length and fine quality of pile is requisite ; but the hazard of the blow-fly, and the chance of losing in hedges and brakes any part of a fleece after it is once fit for a manufacture, will not allow of this practice becoming general, admitting even that the sheep suffer nothing in the proof during the summer months from the weight of the fleece, which in a large scale of practice is improbable, and that the wool should be found to pay as well for growing to this length, as it would when shorn in common course ; but we have taken the liberty of noticing a circumstance so novel to us, because our English breeds are all supposed to cast their fleeces at a certain season of the year, if not shorn, with exception to lambs which hold their fleeces ; (this is quoted by many as an argument against shearing lambs :) because the fact has also been doubted by some of the best informed and liberal amongst us, not supposing the reporters of Rambouillet meant to deceive, but that some mistake must have been made. A sample of this wool is now in England ; I have carefully examined it, and can bear testimony to the fact Salt is not given to sheep in Prussia and in Holland ; but in Sweden, in Saxony, in Silesia, and in France it is considered a most important article, and is strongly recommended on the same principle, as we had before laboured to induce its adoption in these kingdoms.

We had no doubt of the good effect of salt on mouldy hay; but it remained to be proved, how good hay, which had not spent its strength in premature fermentation, would bear such a quantity of salt as would invigorate the stomach, quicken the circulation of blood, and excite in cattle a desire to drink largely. Some medical men, aware of our practice, conjectured that salt tends to decompose and convert water to nourishment in an increased degree. Whether this is, or is not, to be so accounted for, we are incompetent to judge. But it is our business to know the effect it has on stock; and we do know, that it surpasses all belief. Some of our hay, lately in use, was of the first quality of sheep hay, the produce of rich and deep loam on a lime stone bottom; it was put together without wet, and had 25 lb. of salt per ton sprinkled through a sieve, a greater quantity than has yet been used. In colour, flavour, and proof, it equalled any hay whatever, and satisfies us that this, or a greater quantity of salt, may be infused into hay of the best quality, and with the best possible effect. In confirmation of this fact, we have also the authority of Mr. Darke of Breedon, one of the most celebrated graziers in the kingdom, who has mixed salt with his flooded mouldy hay, 8 lb. of salt only to a ton, and he declares, that his Hereford oxen did better on it than others on the best hay he had, and that he was, and is convinced, that the hay had all its good effect from the salt.

In Spain, a thousand sheep use in five months four arobes, or one quintal of salt, which is 128lb. Their sheep would fat to 13 lb. per quarter upon the average ; this is the quantity given out, all of which may not be consumed : and as the price of salt in that country is no object, more would have been given, if more was necessary. The quantity given to our sheep was such, as we have before stated would keep them healthy, or such, as they appeared to demand. It is given in the morning when the sheep are looked over, in order to counteract the ill effect of the dew. They have consumed at the rate of one ton of salt, for every thousand sheep annually.

A small handful is put on a flat stone or slate, and ten or fifteen of these slates, set a few yards apart, are enough for one hundred sheep. At first the sheep may be moved towards them ; if they feel a craving for salt they will lick up quickly as much as is necessary ; if they do not want it, what remains dry when the sheep are next looked at, is taken up and reserved for future use. Twice a week has usually been found sufficient ; in particular cases it may be offered thrice. As to any doubt respecting their inclination to it none can be maintained ; for in the year 1801, of a flock approaching towards 1000, there are not ten old sheep, which have not taken kindly to it, and not a lamb which does not consume it greedily.

To the Trustees of the Agricultural Society.

GENTLEMEN,

Let the following Miscellaneous articles appear among your papers, and oblige your's, &c. A. B.
Boston, June 1808.

....

To lovers of gardening it may not be unacceptable to know, that painting the walls black greatly forwards the ripening of fruit. Experience has proved, that a vine of an uncommon size, which, even in the hottest years, would not produce any ripe fruit, has now, for several years, regularly yielded the finest grapes ; all other fruit, the trees of which are planted against that black wall, ripen much sooner than those in the neighbourhood.

....

The following is recommended to all Dairy-Women.

To prevent that rancid, nauseous flavour, which is too often prevalent in cheeses, even when made of the richest milk, and which otherwise would be delicious, salt the milk as soon as it is taken from the cows. I mean the evening's milk, which is kept in pans, during the night, in order to be mixed with the new morning's milk. The quantity of salt, used on this occasion, is about a table spoonful to each gallon of milk, and is generally sprinkled on the bottom of the pan, and the milk poured upon the salt, and they soon become incorporated. This early salting has enabled many dairy-women, whose cheese was before always hoven and detestably rank, now to produce excellent well flavored cheese, and on farms that had been pronounced totally unfit for the dairy system. To this small portion of salt, various good effects are attributed by those who use it ; they say, it prevents the milk from souring, in the hottest nights ; that it encourages coagulation, and very much promotes the separation of the curd from the whey, which is a great saving. All dairy women ought also to know, that it is a false idea, and a loss instead of a gain to the proprietor, to rob cheese of a single particle of butter ; and for these two reasons, because a pint of cream will produce more than treble the quantity of curd, that a pint of skimmed milk will give ; and because a cheese, with all the butter left in it, will lose very little of its weight by keeping, whereas that, from which the butter has been avariciously taken, will lose one third of its original weight in twelve months.

....

Boiling Grain, given to Horses, recommended.

It is satisfactorily ascertained, that boiling grain of all sorts for horses, and giving them the liquor likewise, will keep them in better condition, than double the quantity in a crude state.

....

The intelligent Farmer will find something more than amusement in the following calculations.

IN AN ACRE ARE

4 roods, in each rood 40 rods, poles or perches,
160 rods, of $16\frac{1}{2}$ feet each,
4840 square yards, 9 feet each,
43560 square feet, 144 inches each,
174240 squares, of 6 inches each, 36 inches,
6272640 inches, or squares of 1 inch each.

....

In the following table may be seen how many trees or plants may be raised in a rod of land, at different distances.—Note, in a rod, are $272\frac{1}{4}$ square feet, or 39204 square inches. *(all fractions are omitted.)*

Plants.	*No of inches asunder.*	*Sq. inches to each.*
2450	4 *by* 4	16
1960	5—4	20
1633	6—4	24
1089	6—6	36
816	8—6	48
612	8—8	64
490	10—8	80
392	10—10	100
261	15—10	150

To shew how many trees or plants, hills of corn, or potatoes, an acre will contain, at different distances—(fractions omitted.)

Trees or Plants.	*No. of feet asunder.*	*Sq. ft. to each.*
108	20ft.	400
160	16½	272¼
134	18	324
302	12	144
435	10	100
680	8	64
888	7	49
1089	8 *by* 5	40
1210	6	36
1361	8 *by* 4	32
1452	6—5	30
1555	7—4	28
1815	6—4	24
2178	5—4	20
2722	4—4	16
2904	5—3	15
3630	4—3	12
4840	3—3	9
5445	4—2	8
7260	3—2	6
8712	2½—2	5
10890	2—2	4
19305	1½—1½	2¼
21780	2—1	2
43560	1—1	1

....

A bushel of middle sized wheat is supposed to contain about 500,000 grains; if this number be divided by the number of square yards in an acre, one bushel sown on an acre gives 103 grains and $\frac{3}{10}$ths on each square yard; on each square foot, consequently, 11 grains and ½; consequently each square space, measuring $3\frac{1}{2}$ inches on each side, would, (on an average) have one seed deposited on it. Hence is deduced the following table.

Bushels sown.	Grains contained.	On a sq. yard.	On a square foot.	One grain on a square of
1	500,000	103 $\frac{3}{10}$ths.	$11\frac{1}{2}$	$3\frac{1}{2}$ inches.
2	1,000,000	206 $\frac{6}{10}$ths.	23	$2\frac{1}{2}$
$2\frac{1}{2}$	1,250,000	258 $\frac{7}{10}$ths.	$28\frac{1}{4}$	$2\frac{1}{4}$
3	1,500,000	300 $\frac{9}{10}$ths	$34\frac{1}{2}$	2
$3\frac{1}{2}$	1,750,000	361 $\frac{5}{10}$ths.	$40\frac{1}{4}$	$1\frac{9}{10}$ths.

Propagation and culture of the common Parsnep, from MILLER's *Horticultural Dictionary.*

THE Parsnep is cultivated in kitchen-gardens, the roots being large, sweet, and accounted very nourishing. It is propagated by seeds, which should be sown in February or March, in a rich mellow soil, well dug, that their roots may run downwards, the greatest excellency being the length and bigness of the roots. These may be sown alone, or with Carrots, as is practised by the kitchen gardeners near London; some of whom also mix Leeks, Onions, and Lettuce, with their Parsneps; but this I think very wrong, for it is not possible, that so many different sorts can thrive well together, except they are allowed a considerable distance; and if so, it will be equally the same to sow the different sorts separate. However, Carrots and Parsneps may be sown together very well, especially where the Carrots are designed to be drawn off very young; because the Parsneps generally spread most towards the end of the summer, when the early Carrots are gone.

When the plants are come up, hoe them out to ten or twelve inches asunder, cutting up all the weeds This must be repeated three or four times, according as you find the weeds grow ; but in the latter part of the summer, when the plants cover the ground, they will prevent the growth of weeds.

When the leaves begin to decay, the roots may be dug up for use. Before this they are seldom well tasted ; nor are they good for much in the spring, after they are shot out again. To preserve them for this season, dig them up the beginning of February, and bury them in sand in a dry place, where they will remain good until the middle of April or later.

To save seeds make choice of some of the longest, straightest, and largest roots, and plant them two feet asunder, where they are defended from strong south and south-west winds, for the stems grow to a great height ; keep them clear from weeds, and if the season should prove dry, water them twice a week. At the end of August, or the beginning of September, the seeds will be ripe ; then carefully cut off the umbels, and spread them upon a coarse cloth for two or three days to dry ; after which, beat off the seeds and put them up for use. Never trust to the seeds that are more than a year old, for they will seldom grow beyond that age.

The leaves are dangerous to handle, especially in a morning, while the dew remains upon them. I have known gardeners, when they have been drawing up Carrots from among Parsneps, when their leaves were wet with dew, and have turned the sleeves of their shirts up to their should rs, have their arms covered with large blisters, full of a scalding liquor, which have proved very troublesome for several days.

To cultivate Parsneps, let the farmer sow the seed in autumn, soon after it is ripe ; by which means the plants will come on early the following spring, and will get strong before the weeds can grow so as to injure them. The young plants never materially suffer through the severity of the seasons.

The best soil for them is a rich deep loam; next this is sand, or they will thrive well in a black gritty soil; but will never pay for cultivating in stone, brush, gravel, or clay soils; and they are always the largest, where the staple is deepest. If the soil be proper, they do not require much manure. A very good crop has been obtained for three successive years without any. Forty cart-loads of sand laid on an acre of very stiff loam, and ploughed in, has answered very well.

Sow the seeds in drills eighteen inches distant, that the plants may be horse or hand-hoed: they will be more luxuriant if they have a second hoeing, and are carefully earthed so as not to cover the leaves.

If land cannot be got in proper condition to receive the seed in autumn, sow a plat in the garden or the corner of a field, and transplant them at the end of April or early in May. The plants must be carefully drawn, and the land that is to receive them well pulverized by harrowing and rolling. When it is thus in order, open a furrow six or eight inches deep, and lay the plants in it regularly at the distance of ten inches or a foot, taking care not to let the root be bent, and that the plant stand upright after the earth is closed about it, which should be done immediately by persons following the planter with a hoe, and who must be attentive not to cover the leaves. Open another furrow eighteen inches distant from the last, plant it as before, and so proceed till the field is completely cropped. When any weeds appear, hoe the ground, and earth the plants.

Dibbling in Parsneps is a bad method, as the ground thereby becomes so bound as not easily to admit the lateral fibres, with which the root of this plant abounds, to fix or work in the earth, on which account the roots never attain their proper size.

With attention to the soil, the season for sowing, cleaning and earthing the plants, and raising the seed from the largest and best Parsneps, there is no doubt but the crop would answer much better than a crop of Carrots. They are equal to them, if not superior, in fatting pigs ; for they make the flesh whiter ; and the animals eat them with more satisfaction. Clean washed and sliced among bran, horses eat them greedily, and thrive with them ; nor do they heat horses, or like corn fill them with disorders.*

In France and our Islands adjoining to it, Parsneps are held in high esteem both for cattle and swine. In Brittanny this crop is said to be little inferiour in value to wheat. Milch cows fed with it in winter give as much and as good milk, and yield butter as well flavoured, with Parsneps, as with grass in May or June.†

The following observations on the Nature of Vegetables, are extracted from the same ingenious English publication, from which large extracts were made in the Society's publication for 1806, *and is a continuation of the same subject.*

ON THE SAP OF PLANTS.

SINCE the food of plants is imbibed by their roots in a fluid state, it must exist in plants in a fluid state ; and unless it undergoes alterations in its

* Hazard, in Bath papers, vol. 4, page 244. † Bath papers, 4, 287

composition just when imbibed, we may expect to find it in the plant unaltered. If there were any method of obtaining this fluid food from plants before it has been altered by them, we might analyze it, and obtain by that means a much more accurate knowledge of the food of plants, than we can by any other method. This plan indeed must fail, provided the food undergoes alteration just when it is absorbed by the roots: but if we consider, that when one species of tree is grafted upon another, each bears its own peculiar fruit and produces its own peculiar substances. The great changes, at least which the food undergoes after absorption, are produced probably not in the roots, but in other parts of the plant.

If this conclusion be just, the food of plants, after being imbibed by the roots, must go directly to those organs, where it is to receive new modifications and to be rendered fit for being assimilated to the different parts of the plant. There ought, therefore, to be certain juices continually ascending from the roots of plants; and these juices, if we could get them pure and unmixed with the other juices or fluids which the plant must contain, and which have been secreted and formed from these primary juices, would be the food as it is imbibed by the plant. Now during the vegetation of plants, there actually is a *juice* continually ascending from their roots. This juice has been called the sap, the succus communis, or the lymph of plants.

The first step towards an accurate knowledge of the food, and of the changes which take place during vegetation, is an analysis of the sap. The sap is most abundant during the spring. At that season, if a cut be made through the bark and part of the wood of some trees, the sap flows out very profusely. By this contrivance, any quantity of sap we think proper may be collected. It is not probable, indeed, that by this method we obtain the ascending sap in all its purity: it is no doubt mixed with the peculiar juices of the plant; but the less progress vegetation has made, the purer we may expect to find it; because the peculiar juices must be in much smaller quantity. We should, therefore, examine the sap as early in the season as possible, and at all events before the leaves have expanded.

For the most complete set of experiments hitherto made upon the sap, we are indebted to Mr. VAUQUELIN.* He has neglected to inform us of the state of the tree when the sap which he analyzed was taken from it; so that we are left in a state of uncertainty with respect to the purity of the sap: but from the comparison which he has put it in our power to draw between the state of the sap at different successive periods, we may in some measure obviate this uncertainty.

He found that 1039 parts of the sap of the common elm, were composed of

Water and volatile matter,
Acetite of potass,
Vegetable matter,
Carbonat of lime.

On analyzing the same sap somewhat later in the season, Mr VAUQUELIN found the quantity of vegetable matter a little increased, and that of the acetite of potass diminished. Still later in the season the vegetable matter was farther increased, and the other ingredients farther diminished.

The carbonat of lime was held in solution by carbonic acid, of which there existed a considerable excess in the sap. It is to this acid gas that the air-bubbles, which so often accompany the sap, as it issues from the tree, are owing.†

* Ann. de Chim. xxxi. 32. and Jour. de Phys. xlix. 38.
† See Coulomb, Jour. de Phys. xlix. 392.

The sap of the beech, contained the following ingredients:

Water,
Acetite of lime with excess of acid,
Acetite of potass,
Gallic acid,
Tan,
A mucous and extractive matter,
Acetite of Alumina.

Although Mr. VAUQUELIN made two different analyses of this sap at different seasons, it seems clear that the gallic acid and tan were combined together; for the sap tasted like the infusion of oak bark. The quantity of each of these ingredients increased as vegetation advanced; for the colour of the second sap, collected later, was much deeper than that of the first. This shews us that they did not form a part of the ascending sap. Probably they were derived from the bark of the tree. The presence of alumina, and the absence of the carbonic acid gas, would, seem to indicate, that all plants do not imbibe the very same food.

These experiments lead to the conclusion, that acetous acid forms a component part of the sap. Now it is not easy to suppose, that this substance is actually absorbed by the roots in the state of acetous acid. The thing might be determined by examining the mould in which plants grow. This examination indeed has been performed, and the acetites have been found, but not in any great quantity. Is it not probable that the food, after it is imbibed, is somewhat modified and altered by the roots? In what manner this is done we cannot say, as we know very little about the vascular structure of the roots. We may conclude, however, that this modification is nearly the same in most plants: for one plant may be engrafted on another, and each continue to produce its own peculiar products; which could not be unless the proper substances were conveyed to the digestive organs of all. There are several circumstances, however, which render the modifying power of the roots somewhat probable. The strongest of these is the nature of the ingredients found in the sap It is even possible that the roots may by some means or other, throw out again some part of the food, which they have imbibed as excrementitious. This has been suspected by several physiologists, and there are several circumstances which render it probable. It is well known that some plants will not vegetate well after others; and that some again vegetate unusually well when planted in ground where certain plants had been growing. These facts, without doubt, may be accounted for on other principles. If there be any excrementitious matter emitted by the roots, it is much more probable that this happens in the last stage of vegetation. That is to say, when the food, after digestion, is applied to the purposes which the root requires. But the fact ought to be supported by experiments, otherwise it cannot be admitted.

The sap, as Dr. Hales has shewn us, ascends with very considerable force. It issued during the bleeding season with such impetuosity from the cut end of a vine branch, that it supported a column of mercury $32\frac{1}{2}$ inches high.*

It is certain that the sap flows from the roots towards the summit of the tree, for if in the bleeding season a number of openings be made in the tree, the sap begins first to flow from the lowest opening, then from the lowest but one, and so on successively, till at last it makes its appearance at the highest of all. And when Duhamel and Bonnet made plants vegetate in coloured liquors, the colouring

* Veg. Stat. i. 105.

matter, which was deposited in the wood, appeared first in the lowest part of the tree, and gradually ascended higher and higher, till at last it reached the top of the tree, and tinged the very leaves.

It seems certain, too, that the sap ascends through the wood, and not through the bark of the tree; for a plant continues to grow even when stript of a great part of its bark; which could not happen if the sap ascended through the bark. When an incision, deep enough to penetrate the bark, and even part of the wood, is carried quite round a branch, provided the wound be covered up from the external air, the branch continues to vegetate as if nothing had happened; which could not be the case if the sap ascended between the bark and the wood. It is well known, too, that in the bleeding season little or no sap can be got from a tree unless our incisions penetrate deeper than the bark.

These conclusions have been confirmed by the experiments made lately by COULOMB and KNIGHT.—COULOMB observed that no sap ever flows from the poplar till the tree be cut nearly to the centre.*

GREW and MALPIGHI, the first philosophers who examined the structure of plants, took it for granted that the woody fibres were tubes, and that the sap ascended through them. For this reason they gave these fibres the name of lymphatic vessels. But they were unable, even when assisted by the best microscopes, to detect any thing in these fibres which had the appearance of a tube; and succeeding observers have been equally unsuccessful. The conjecture, therefore, of MALPIGHI and GREW, about the nature and use of these fibres, remains totally unsupported by any proof. DUHAMEL has even gone far to overturn it altogether. For he found

* Jour. de Phys. xlix. 392.

that these woody fibres are divisible into smaller fibres, and these again into still smaller; and even by the assistance of the best microscopes, he could find no end of this subdivision.* Now granting these fibres to be vessels, it is scarcely possible, after this, to suppose that the sap really moves through tubes, whose diameters are almost infinitely small. There are, however, vessels in plants which may easily be distinguished by the help of a small microscope, and even in many cases by the naked eye. These were seen, and distinctly described, by GREW and MALPIGHI. They consist of a fibre twisted round like a corkscrew. If we take a small cylinder of wood, and wrap round it a slender brass wire, so closely that all the rings of the wire touch each other, and if, after this, we pull out the wooden cylinder altogether, the brass wire thus twisted will give us a very good representation of these vessels. If we take hold of the two ends of the brass wire thus twisted, and pull them, we can easily draw out the wire to a considerable length. In the same manner, when we lay hold of the two extremeties of these vessels, we can draw them out to a great length. MALPIGHI and GREW finding them always empty, concluded that they were intended for the circulation of the air through the plant, and therefore gave them the name of tracheœ; which word is used to denote the *windpipe* of animals. These tracheœ are not found in the bark; but HEDWIG has shewn that they are much more numerous in the wood than was supposed; and that they are of very different diameters; and REICHEL has demonstrated that they go to the minutest branches, and spread through every leaf. He has shewn, too, that they contain sap; and HEDWIG has proved that the notion which generally prevailed of their contain-

* Physique des Arbres, 57.

ing nothing but air, arose from this circumstance, that the larger tracheœ, which alone were attended to, lose their sap as soon as they are out; and of course, unless they are inspected the instant they are divided, they appear empty.* Is it not probable, then, or rather is it not certain, from the discoveries of that very ingenious physiologist, that the tracheœ are, in reality, the sap vessels of plants? Indeed it seems established by the experiments both of Reichel and Hedwig, that all, or almost all, the vessels of plants may, if we attend only to their structure, be denominated *tracheœ.*

But by what powers is the sap made to ascend in these vessels? And not only to ascend, but to move with very considerable force; a force, as Hales has shewn, sufficient to overcome the pressure of 43 feet perpendicular of water?†

Grew ascribed this phenomenon to the levity of the sap; which according to him, entered the plant in the state of a very light vapour. But this opinion will not bear the slightest examination. Malpighi supposed that the sap was made to ascend by the contraction and dilation of the air contained in the air vessels. But even were we to grant that the tracheœ are air vessels, the sap, according to this hypothesis, could only ascend when a change of temperature takes place; which is contrary to fact. And even if we were to wave every objection of that kind, the hypothesis would not account for the circulation of the sap, unless the sap vessels be provided with valves. Now the experiments of Hales and Duhamel shew that no valves can possibly exist in them. For branches imbibe moisture nearly equally by either end; and consequently the sap moves with equal facility both upwards and down-

* Fundament. Hist. Nat. Muscor. Fondes, part i. p. 54.
† Veget. Stat. i. 167.

wards, which it could not do, were there valves in the vessels. Besides, it is well known, from many experiments, that we may convert the roots of a tree into the branches, and the branches into the roots, by covering the branches with earth, and exposing the roots to the air. Now this would be impossible if the sap vessels were provided with valves. The same remarks overturn the hypothesis of Mr. De la Hire, which is merely that of Malpighi, expressed with greater precision, and with a greater parade of mechanical knowledge.

The greater number of philosophers have ascribed the motion of the sap to capillary attraction.

There exists an attraction between many solid bodies and liquids; in consequence of which, if these solid bodies be formed into small tubes, the liquid enters them, and rises in them to a certain height. But this is perceptible only when the diameter of the tube is very small. Hence the attraction has been denominated capillary. We know that there is such an attraction between vegetable fibres and watery liquids; for such liquids will ascend through dead vegetable matter. It is highly probable, therefore, that the food of plants enters the roots, in consequence of the capillary attraction which subsists between the sap vessel and the liquid imbibed.—This species of attraction, then, will account perfectly well for the entrance of moisture into the mouths of the sap vessels.

But the first person who gave a precise view of the manner in which the vessels probably act was Saussure. He supposes that the sap enters the open mouths of the vessels, at the extrem ty of the roots; that these mouths then contract, and by that contraction propel the sap upwards; that this contraction gradually follows the sap, pushing it up from the extremity of the root to the summit of the plant. In the mean time the mouths are receiving new sap, which in the same manner is pushed upwards * Whether we suppose the contraction to take place precisely in this manner or not, we can scarcely deny that it must take place ; but by what means it is impossible at present to say. The agents cannot precisely resemble the muscles of animals ; because the whole tube, however cut or maimed, still retains its contracting power, and because the contraction is performed with equal readiness in every direction.† It is evident, however, that they must be the same in kind. Perhaps the particular structure of the vessels may fit them for their office. The contracting agents, whatever they are, seem to be excited to act by some stimulus communicated to them by the sap. This capacity of being excited to action is known in physiology by the name of irritability ; and there are not wanting proofs that plants are possessed of it. It is well known that different parts of plants move when certain substances act upon them. Thus the flowers of many plants open at sunrise, and close again at night. LINNÆUS has given us a list of these plants. DES TONTAINES has shewn that the stamina and antheræ of many plants exhibit distinct motions.‡ But every one has it in his power to make a decisive experiment. Simply cutting a plant, in two places, so as to separate a portion of the stem from the rest, is a complete demonstration that the vessels actually

* Encycl. Meth. Phys. Veget. p. 267.

† Mr. KNIGHT thinks it probable that the sap is propelled by the contraction and expansion of what is called by carpenters the silver grain of wood, between the laminæ of which the vessels run, (Phil. Trans. 1801, p. 344.) By silver grain, is meant those thin longitudinal fibres, diverging in every direction from the pith, and composed of the lymphatic vessels of GREW and MALPIGHI. I do not see how the contraction of these laminæ could propel the sap through the sap vessels, destitute as they are of valves, unless it were a contraction precisely similar to what SAUSSURE supposed to take place in the sap vessels.

‡ Mem. Par. 1787.

do contract. For whoever makes the experiment will find that the milky juice of that plant flows out at both ends so completely, that if afterwards we cut the portion of the stem in the middle, no juice whatever appears. Now it is impossible that these phenomena could take place without a contraction of the vessels; for the vessels in that part of the stems which has been detached cannot have been more than full; and their diameter is so small, that if it were to continue unaltered, the capillary attraction would be more than sufficient to retain their contents, and consequently not a drop would flow out. Since, therefore, the whole liquid escapes, it must be driven out forcibly, and consequently the vessels must contract.

It seems pretty plain, too, that the vessels are excited to contract by various stimuli; the experiments of COULON and SAUSSURE render this probable, and an observation of Dr. SMITH BARTON makes it next to certain. He found that plants growing in water vegetated with much greater vigour, provided a little camphor was thrown into the water.*

Functions of the Leaves during the Day.

It has been ascertained that the sap ascends to the leaves, that there it undergoes certain alterations, and is converted into another fluid called the succus proprius, or peculiar juice, which, like the blood in animals, is afterwards employed in forming the various substances found in plants. Now the changes which the sap undergoes in the leaves, provided we can trace them, must throw a great deal of light upon the nature of vegetation. These changes are produced in part during the day, in part during the night. As the functions of the leaves during the

* Ann. de Chim. xxiii. 63.

day are very different from what they are during the night, it will be proper to consider them separately.

No sooner has the sap arrived at the leaves, than a great part of it is thrown off by evaporation.

The quantity thus perspired bears a very great proportion to the moisture imbibed. Mr. WOODWARD found that a sprig of mint in 77 days imbibed 2558 grains of water, and yet its weight was only increased 15 grains;* therefore, it must have given out 2543 grains. Another branch, which weighed 127 grains, increased in weight 128, and it had imbibed 14190 grains. Another sprig, weighing 76 grains, growing in water mixed with earth, increased in weight 168 grains, and had imbibed 10731 grains of water. These experiments demonstrate the great quantity of matter which is constantly leaving the plant. Dr. HALES found that a cabbage transmitted daily a quantity of moisture equal to about half its weight, and that a sun-flower three feet high, transmitted in a day 1 lb. 14 ozs † He shewed, that the quantity of transpiration in the same plant was proportional to the surface of the leaves, and that when the leaves were taken off, the transpiration nearly ceased.‡ By these observations, he demonstrated that the leaves are the organs of transpiration. He found, too, that the transpiration was nearly confined to the day, very little taking place during the night,§ that it was much promoted by heat, and stopped by rain and frost. || And MILLAR,¶ GUETTARD,** and SENNEBIER, have shewn that the transpiration is also very much promoted by sunshine.

The quantity of moisture imbibed by plants depends very much upon what they transpire: The reason is evident: When the vessels are once filled

* Phil. Trans. No. ccliii. † Veget. Stat. 1. 5, & 15. ‡ Ibid 30. § Veget. Stat. 5. || Ibid. 27, & 48. ¶ Ibid, 22. ** Mem. Par. 1748.

with sap, if none be carried off, no more can enter; and of course, the quantity which enters must depend upon the quantity emitted.

In order to discover the nature of the transpired matter, HALES placed plants in large glass vessels, and by that means collected a quantity of it.* He found that it resembled pure water in every particular, excepting, that it sometimes had the odour of the plant. He remarked, too, as GUETTARD and DUHAMEL did after him, that when kept for some time it putrefied.

The first great change, which takes place upon the sap after it arrives at the leaves, is the evaporation of a great part of it; consequently what remains must be very different in its proportions from the sap. The leaves seem to have particular organs adapted for throwing off part of the sap by transpiration. For the experiments of GUETTARD,† DUHAMEL,‡ and BONNET,§ shew that it is performed chiefly by the upper surfaces of leaves, and may be nearly stopped altogether by varnishing the upper surface.

The leaves of plants become gradually less and less by this transpiration; for SENNEBIER found that when all other things are equal, the transpiration is much greater in May than in September. || Hence the reason that the leaves are renewed annually.— Their organs become gradually unfit for performing their functions, and therefore, it is necessary to renew them. Those trees, which retain their leaves during the winter, were found by HALES and succeeding physioligists to transpire less than others. It is now well known that these trees also renew their leaves.

* Veget Stat. i. 49.
† Mem. Par. 1749.
‡ Physique des Arbres. i. 158.
§ Traite des Feuilles I. Mem.
|| Encyc. Meth. Veget. 285.

Leaves have also the property of absorbing carbonic acid gas from the atmosphere.

We are indebted for this very important discovery to the experiments of Dr. PRIESTLEY. It has been long known that when a candle has been allowed to burn out in any quantity of air, no candle can afterwards be made to burn in it. In the year 1771, Dr. PRIESTLEY made a sprig of mint vegetate for ten days in contact with a quantity of such air; after which he found that a candle would burn in it perfectly well.* This experiment he repeated frequently, and found that it was always attended with the same result.

Mr SAUSSURE has shewn that plants will not vegetate when totally deprived of carbonic acid gas. But when a quantity of lime was put into the glass vessel which contained them, they no longer continued to grow, and the leaves in a few days fell off.† The air when examined, was found to contain no carbonic acid gas. The reason of this phenomenon is, that plants (as we shall see afterwards) have the power of forming and giving out carbonic acid in certain circumstances; and this quantity is sufficient to continue their vegetation for a certain time. But if this new formed gas be also withdrawn, by quicklime for instance, which absorbs it the instant it appears, the leaves droop, and refuse to perform their functions. Carbonic acid gas, then, applied to the leaves of plants, is essential to vegetation.

Dr. PRIESTLEY, to whom we are indebted for many of the most important facts relative to vegetation, observed, in the year 1778, that plants, in certain circumstances, emitted oxygen gas;‡ and INGENHOUSZ very soon after discovered that this gas is emitted by the leaves of plants, and only when

* On Air, iii, 251.
† Ann. de Chim. xxiv. 145, 148.
‡ On Air, iii, 284.

they are exposed to the bright light of day. His method was to plunge the leaves of different plants into vessels full of water, and then expose them to the sun. Bubbles of oxygen gas very soon detached themselves from the leaves, and were collected in an inverted glass vessel.* He observed, too, that it was not a matter of indifference what kind of water was used. If the water, for instance, had been previously boiled, little or no oxygen gas escaped from the leaves; river water afforded but little gas; but pump water was the most productive of all.†

SENNEBIER proved, that if the water be previously deprived of all its air by boiling, the leaves do not emit a particle of air; that those kinds of water which yield most air, contain in them the greatest quantity of carbonic acid gas; that leaves do not yield any oxygen when plunged in water totally destitute of carbonic acid gas; that they emit it abundantly when the water, rendered unproductive by boiling, is impregnated with carbonic acid gas; that the quantity of oxygen emitted, and even its purity, is proportional to the quantity of carbonic acid gas which the water contains; that water impregnated with carbonic acid gas gradually loses the property of affording oxygen gas with leaves; and that whenever this happens, all the carbonic acid gas has disappeared; and on adding more carbonic acid gas the property is renewed.‡ These experiments prove, in a most satisfactory manner, that the oxygen gas which the leaves of plants emit depends upon the presence of carbonic acid gas; that the leaves absorb carbonic acid gas, decompose it, give out the oxygen, and retain the carbon.

We now see why plants will not vegetate without carbonic acid gas. They absorb it and decompose

* Ingenhousz on Veget. I. 15, &c. † Ingenhousz on Veget. i. 83.
‡ Encyc. Meth. Phys. Veget. 181.

it; but this process goes on only when the plants are exposed to the light of day. Therefore, we may conclude, that the absorption and decomposition of carbonic acid gas is confined to the day, and that light is an essential agent in the decomposition. Probably it is by its agency, or by its entering into combination with the oxygen, that this substance is enabled to assume the gaceous form, and to separate from the carbon

It is extremely probable that plants by this process acquire the greatest part of the carbonaceous matter which they contain; for if we compare the quantity of carbon contained in plants vegetating in the dark, where this process cannot go on, with the quantity which those plants contain which vegetate in the usual manner, we shall perceive a very conspicuous difference. CHAPTAL found that a byssus, which was vegetating in the dark, contained only $\frac{1}{89}$ of its weight of carbonaceous matter; but the same plant, after being made to vegetate in the light for 30 days, contained $\frac{1}{24}$ of its weight of carbonaceous matter.* HASSENFRATZ ascertained, that plants growing in the dark contain much more water, and much less carbon and hydrogen, than plants growing in the light. SENNEBIER analyzed both with the same result. Plants growing in the dark yielded less hydrogen gas and oil: their resinous matter was to that of plants growing in the light as 2 to 5. 5, and their moisture as 13 to 6; they contain even one half less of fixed matters.

It is evident, however, that this absorption and decomposition of carbonic acid gas does not depend upon the light alone. The nature of the sap has also its influence; for HASSENFRATZ found, that the quantity of carbon did not increase when plants vegetate in pure water. Here the sap seems to have

* Mem, Par. 1786.

wanted that part which combines with and retains the carbon; and which, therefore, is by far the most important part of the food of plants. Upon the discovery and mode of applying this substance, whatever it is, the improvements in agriculture must in a great measure depend.

SENNEBIER has ascertained, that the decomposition of the carbonic acid takes place in the parenchyma. He found, that the epidermis of a leaf would, when separated, give out no air, neither would the nerves in the same circumstances; but upon trying the parenchyma, thus separated from its epidermis and part of its nerves, it continued to give out oxygen as before.* He remarked also, that every thing else being equal, the quantity of oxygen emitted, and consequently of carbonic acid decomposed, is proportional to the thickness of the leaf; and this thickness depends upon the quantity of parenchyma.

That the decomposition is performed by peculiar organs, is evident from an experiment of INGENHOUSZ. Leaves cut into small pieces continued to give out oxygen as before; but leaves pounded in a mortar lost the property entirely. In the first state, the peculiar structure remained; in the other, it was destroyed.

Such are the operations performed by the leaves during the day. They seem in some measure to depend upon the action of light; for they never take place except when the leaves are exposed to the influence of light.

The green colour of plants is owing entirely to their vegetating in the light; for when they vegetate in the dark they are white; and when exposed to the light they acquire a green colour in a very short time, in whatsoever situation they

* Encyc. Method. Physiol. Veget. 180.

are placed, even though plunged in water, provided always that oxygen be present; for Mr. GOUGH has shewn, that light without oxygen has not the power of producing the green colour.*

SENNEBIER has observed, that when plants are made to vegetate in the dark, their etiolation is much diminished by mixing a little hydrogen gas with the air that surrounds them.† INGENHOUSZ had already remarked, that when a little hydrogen gas is added to the air in which plants vegetate, even in the light, it renders their verdure deeper:‡ and he seems to think also, that he has proved by experiments, that plants absorb hydrogen gas in these circumstances.§ And several plants which grow in the galleries of mines, retain their green colour even in the dark, and that in these cases the air around them contains a quantity of hydrogen gas. This may perhaps be true in certain cases; but the experiments of Mr. GOUGH, mentioned above, are sufficient to prove that the retention of oxygen is not the only difference between green and etiolated plants. ||

Functions of the Leaves during the Night.

During the day, then, the leaves of plants exhale moisture and oxygen gas, and absorb carbonic acid gas; let us now endeavour to trace the operations which they perform during the night.

Plants will not vegetate unless atmospheric air or oxygen gas have access to their leaves. This was rendered probable by those philosophers who, about

* Manch. Mem. iv. 501. † Encyc. Meth. Physiol. Veget. 77.
‡ Ann. de Chim. iii. 57. § Ibid. p. 61.
|| Plants of a white colour, are called etiolated, from a French word which signifies a star, as if they grew by star light.

the end of the 17th century, turned their attention particularly towards the physical properties of the air. But Dr. INGENHOUSZ was perhaps the first of the modern chemists who put it beyond doubt. He found that carbonic acid gas, azotic, and hydrogen gas, destroyed plants altogether, unless they were mixed with atmospheric air or oxygen gas. He found also, that plants grew very well in oxygen gas and in atmospheric air.* These experiments are sufficient to shew that oxygen gas is necessary to vegetation. The leaves of plants seem to absorb it; and most probably this absorption takes place only in the night. We know at least, that in germination light is injurious to the absorption of oxygen gas; and, therefore, it is probable that this is the case also in vegetation.

The leaves of plants not only absorb oxygen gas, but water also. This had been suspected in all ages: the great effect which dew, slight showers, and even wetting the leaves of plants have in recruiting their strength, and making them vegetate with vigour, are so many proofs that the leaves imbibe moisture from the atmosphere. HALES rendered this still more probable, by observing, that plants increase considerably in weight when the atmosphere is moist; and Mr. BONNET put the matter beyond doubt in his researches concerning the use of the leaves. He shewed that leaves continue to live for weeks when one of their surfaces is applied to water; and that they not only vegetate themselves, but even imbibe enough of water to support the vegetation of a whole branch, and the leaves belonging to it. He discovered also, that the two surfaces of leaves differ very considerably in their power of imbibing moisture; that in trees and

* INGENHOUSZ, ii. passim.

shrubs, the under surface possess almost the whole of the property, while the contrary holds in many of the other plants; the kidney bean for instance.

These facts prove, not only that the leaves of plants have the power of absorbing moisture, but also that the absorption is performed by very different organs from those which emit moisture. If we consider that it is only during the night that the leaves of plants are moistened with the dew, we can scarcely avoid concluding that, except in particular cases, it is during the night that plants imbibe almost all the moisture which they do imbibe.

During the night the leaves of plants emit carbonic acid gas. This fact was first demonstrated by Dr. INGENHOUSZ,* and it has been since confirmed by every philosopher who has attended to the subject.

Whether the emission of carbonic acid be occasioned by the combination of oxygen absorbed with the carbon of the sap, or by the decomposition of water has not been ascertained. What gives probability to the first is, that the absorption of oxygen and the emission of carbonic acid take place at the same time. It is extremely probable that there is also a decomposition of water going on in the sap. But if such a decomposition takes place, it depends in a good measure upon the quantity of oxygen gas absorbed; for Dr. INGENHOUSZ found that when plants are confined in oxygen gas, they emit more carbonic acid gas than when they are confined in common air.†

Of the peculiar Juices of Plants.

By these changes which go on in the leaves, the nature of the sap is altogether changed. It is now

* On Vegetables, i. 47. and ii passim. † INGENHOUSZ, ii.

converted into what is called the peculiar juice, and is fit for being assimilated to the different parts of the plant, and for being employed in the formation of those secretions which are necessary for the purposes of the vegetable economy.

The leaves, therefore, may be considered as the digesting organs of plants, and as equivalent in some measure to the stomach and lungs of animals. The leaves consequently are not mere ornaments; they are the most important parts of the plant. Accordingly we find, that whenever we strip a plant of its leaves, we strip it entirely of its vegetating powers till new leaves are formed. It is well known, that when the leaves of plants are destroyed by insects, they vegetate no longer, and that their fruit never makes any farther progress in ripening, but decays and dries up. Even in germination no progress is made in the growth of the stem till the seed leaves appear. As much food indeed is laid up in the cotyledons as advances the plant to a certain state; the root is prepared, and made ready to perform its functions; but the sap which it imbibes must be first carried to the seed leaves, and digested there, before it be proper for forming the plumula into a stem. Accordingly if the seed leaves are cut off, the plant refuses to vegetate.

It will be very natural to ask, if this be true, how came the leaves themselves to be produced? We know that the leaves exist long before they appear; they have been traced even five years back. They are completely formed in the bud, and fairly rolled up for evolution, many months before that spring in which they expand. We know, too, that if we take a bud, and plant it properly, it vegetates, forms to itself a root, and becomes a complete plant. It will not be said, surely, that in this case the bud imbibes nourishment from the earth; for it has to form a root before it can obtain nourishment in that manner; and this root cannot be formed without nourishment. Is not this a demonstration that the bud contains, already laid up for itself a sufficient quantity of nourishment, not only to develope its own organs, but also to form new ones. This I consider as a sufficient answer to the objection. During the summer, the plant lays up a sufficient quantity of nourishment in each bud, and this nourishment is afterwards employed in developing the leaves. This is the reason that the leaves make their appearance, and that they grow during the winter, when the plant is deprived of its organs of digestion.

Hence we see why the branch of a vine, if it be introduced into a hothouse during the winter, puts forth leaves and vegetates with vigour, while every other part of the plant gives no signs of life. Hence also the cause of another well known phenomenon: The sap flows out of trees very readily in spring before the leaves appear; for as there is no outlet, when the vessels are once full they can admit no more. It appears, however, from the bleeding, that the roots are capable of imbibing, and the vessels of circulating, the sap with vigour. Accordingly whenever there is an outlet, they perform their functions as usual, and the tree bleeds; that is they send up a quantity of sap to be digested as usual; but as there are no digesting organs, it flows out and the tree receives no injury, because the sap that flows would not have been imbibed at all, had it not been for the artificial opening. But when the digestive organs appear, the tree will not bleed; because these organs require all the sap, and it is constantly flowing to them.

If a tree be deprived of its leaves, new leaves make their appearance, because they are already prepared for that purpose. But what would be the consequence if a tree were deprived of its leaves and of all its buds for five years back? That plants do not vegetate without their leaves is evident from an experiment of DUHAMEL. He stripped the bark off a tree in ringlets, so as to leave five or six rings of it at some distance from each other, with no bark in the intervals. Some of these rings had buds and leaves; these increased considerably in size; but one ring which had none of these remained for years unaltered. Mr. KNIGHT found, that a shoot of the vine, when deprived of its leaves, died altogether.*

The succus proprius, or peculiar juice of plants, may be considered as analagous to the blood of animals. It is the food altered by digestion, and rendered fit for being assimilated and converted into a part of the plant itself, by the subsequent processes of vegetation. That it flows from the leaves of the plant towards the roots, appears from this circumstance, that when we make an incision into a plant, into whatever position we put it, much more of the succus proprius flows from that side of the wound which is next to the leaves and branches, than from the other side; and this happens even though the leaves and branches be held undermost.† When a ligature is tied about a plant, a swelling appears above, but not below the ligature.

The vessels containing the peculiar juice have been traced by Mr. KNIGHT from the leaves into the cortical layers of the inner bark.‡ HEDWIG, who has examined the vessels of plants with very great care, seems to consider them as of the same structure with the tracheæ; but Mr. KNIGHT is of a different opinion. It appears evidently, from the

* Phil. Trans. 1801, p. 338. † Bell, Manch. Mem. ii. 402.
‡ Phil. Trans. 1801. p. 337.

experiments of this last gentleman, that they communicate with no part of the plant which is situated at a greater distance from the root than the leaf from which they themselves originate. For when two circular incisions are made through the bark of a branch above and below a leaf, and at some distance from it, only that part of the portion confined between the two incisions which is situated below the leaf increases in size.

The peculiar juice is easily known by its colour and its consistence. In some plants it is green, in some red, in many milky. It cannot be doubted that its motion in the vessels is performed in the same way as that of the sap.

In many cases, the peculiar juice may be known by its colour and then its analysis may be performed with an approach towards accuracy. The experiments made on such juices have proved as might have been expected, that they differ very considerably from each other, and that every plant has a juice peculiar to itself. Hence it follows, that the processes which go on in the leaves of plants must differ at least in degree, and that we have no right to transfer the conclusions deduced from experiments in one species of plants to those of another species. It is even probable, that the processes in different plants are not the same in kind; for it is not reasonable to suppose, that the phenomena of vegetation in an agaric or a boletus are precisely the same as those which take place in trees and in larger vegetables on which alone experiments have hitherto been made.

To attempt any general account of the ingredients of the peculiar juice of plants, is at present impossible. We may conclude, however, from the experiments of Chaptal, that it contains the vegetable fibre of wood, either ready formed, or very nearly so ; just as the blood in animals contains a substance which bears a strong resemblance to the muscular fibres.

The peculiar juices of plants contain more carbon, hydrogen and oxygen, and less water, and probably lime also, than the sap. They are conveyed to every part of the plant ; and all the substances which we find in plants, and even the organs themselves, by which they perform their functions, are formed from them. But the thickest veil covers the whole of these processes ; and so far have philosophers hitherto been from removing this veil, that they have not even been able to approach it. All these operations, indeed, are evidently chemical decompositions and combination ; but we neither know what these decompositions and combinations are, nor the instruments in which they are regulated.

Of the Decay of Plants.

Such, as far as I am acquainted with them, are the changes produced by vegetation. But plants do not continue to vegetate for ever ; sooner or later they decay, and wither and rot, and are totally decomposed. This change indeed does not happen to all plants at the end of the same time. Some live only for a single season, or even for a shorter period ; others live two seasons, others three, others a hundred or more ; and there are some plants which continue to vegetate for a thousand years. But sooner or later they all cease to live ; and then those very chemical and mechanical powers which had promoted vegetation combine to destroy the remains of the plant.

Now the phenomena of vegetable life are in general vegetation. As long as a plant continues to vegetate, we say it lives ; when it ceases to vegetate, we conclude that it is dead.

The life of vegetables, however, is not so intimately connected with the phenomena of vegetation that they cannot be separated. Many seeds may be kept for years without giving any symptom of vegetation ; yet if they vegetate when put into the earth, we say that they possess life ; and if we should speak accurately, we must say also that they possessed life even before they were put into the earth : for it would be absurd to suppose that the seed obtained life merely by being put into the earth. In like manner, many plants decay, giving no symptoms of vegetation during winter ; yet if they vegetate when the mild temperature of spring affects them, we consider them as having lived all winter. The life of plants, then, and the phenomena of vegetation, are not precisely the same thing ; for the one may be separated from the other, and we can even suppose the one to exist without the other. We can in many cases decide, without hesitation, that a vegetable is not dead even when no vegetation appears ; and the proof which we have for its life is, that it remains unaltered ; for we know that when a vegetable is dead, it soon changes its appearance, and falls into decay.

Thus it appears that the life of a vegetable consists in two things : 1. In remaining unaltered, when circumstances are unfavourable to vegetation : 2. In exhibiting the phenomena of vegetation when circumstances are favourable. When neither of those two things happens, we say that a vegetable is dead.

The phenomena of vegetation have been enumerated above. They consist in the formation or expansion of the organs of the plant, in the taking in of nourishment, in carrying it to the leaves, in digesting it, in distributing it through the plant, in augmenting the bulk of the plant, in repairing decayed parts, in forming new organs when they are necessary, in producing seeds capable of being converted into plants similar to the parent. The cause of these phenomena, whatever it may be, is the cause also of vegetable life, and may be distinguished by the name of the vegetative principle.

The death of plants, if we can judge from the phenomena, is owing to the organs becoming at last altogether unfit for performing their functions, and incapable of being repaired by any of the powers which the vegetative principle possesses.

Of the Decomposition of Vegetable Substances.

Not only entire plants undergo decomposition after death, but certain vegetable substances also, whenever they are mixed together, and placed in proper circumstances, mutually decompose each other, and new compound substances are produced. These mutual decompositions, indeed, are naturally to be expected, for as all vegetable substances are composed of several ingredients, differing in the strength of their affinity for each other, it is to be supposed that, when two such substances are mixed together, the divellent affinities will, in many cases, prove stronger than the quiescent; and therefore decomposition, and the formation of new compounds, must take place.

Chemists have agreed to give these mutual decompositions which take place in vegetable substances the name of fermentation; a word first introduced into chemistry by VAN HELMONT;* and the new substances produced they have called the products of fermentation. All the phenomena of

* STAHL, Fundament, Chem, i. 124.

fermentation lay for many years concealed in the completest darkness, and no chemist was bold enough to hazard even an attempt to explain them.

The vegetable fermentations or decompositions may be arranged under five heads: namely, that which produces bread; that which produces wine; that which produces beer; that which produces acetous acid or vinegar; and the putrefactive fermentation, or that which produces the spontaneous decomposition of decayed vegetables.

The Trustees with pleasure preserve among their papers the two following letters from the Hon. D. HUMPHREYS, Esq. on a subject of increasing importance to American Manufactures.

....

Boston, Nov. 28th, 1807.

DEAR SIR,

MORE than five years having now elapsed, since the introduction into New-England of the flock of Merino-Sheep, in consequence of which the Society for promoting Agriculture in the State of Massachusetts, were pleased to present to me a Gold Medal, it will doubtless be acceptable to that respectable and patriotic body, to learn that their hopes and expectations concerning the utility of this interesting species of animals have not been disappointed.

The attempt to propagate the pure Merinos in this country has been attended with complete success. The extent of the experiment insures the duration of the unadulterated breed. Instead of degenerating in the quantity or quality of their fleeces, the identical sheep which I brought to this country yield, on an average, half a pound of wool more a piece, than they did at the first shearing after their arrival. Nor, on the nicest and most candid examination, is it found, that there is any finer wool produced in Spain, than that which is now annually shorn from these same imported Merinos and their full-blooded offspring. The rams born in America are, however, generally preferred to those born in Spain, by persons who now make application to my agent for Merino-Rams, to cross the blood of their flocks, in breeding from them by American ewes. It is the opinion of all the farmers in Connecticut, who have been acquainted with the original flock and its descendents, both of the pure and mingled blood, that they are hardier, better adapted to our climate, and more easily nourished both in summer and winter than the common breed of American sheep. They are likewise remarkable for being more gregarious and less disposed to stray or get over fences than the others. Finally, it may truly be asserted, that they preserve the entire character, shape, features and qualities of the best Merinos in Spain.

The mixture of the Spanish with the American blood has succeeded in ameliorating the pile of the fleece beyond my most sanguine expectations As a proof of the superior value of the wool of the half-blooded Merinos, it is a well known truth, that it has been sold for a dollar a pound in Connecticut, and still dearer in New-York, the present season, while the best common wool has been sold for about half that price. The half-blooded Merinos produce more wool than the common sheep, and they ordinarily attain a larger size than the Spanish or American breed, from which they are descended. The facts here stated agree in substance with those established by experience in every country of Europe in which I have travelled, where this breed of sheep has been introduced. In England and France the greatest care and expence are now bestowed, under royal and imperial protection, for its extensive propagation.

A difficulty was experienced at first, in carding the wool by the common carding machines. This has been overcome. Some farmers, who early introduced a mixture of this blood into their flocks, have made, in domestic manufacture, for sale, five or six pieces of cloth from this wool, during the present year. I shall have several hundred yards, fabricated entirely by machinery from pure Merino fleeces. Several thousands, made by the same process, from the common sheep's wool of the country, have already been sent to market. Samples of both kinds, with the prices, are enclosed.

How long a period must pass before the prejudices against the fabricks of our country can be extinguished, is not for me to decide. If any suitable means for their extinction could be devised and adopted, perhaps an essential service would be thereby rendered to the real prosperity and independence of the United States.

With sentiments of great respect and esteem, I have the honour to be, Dear Sir, your most obedient and most humble servant,

D. HUMPHREYS.

Dr. Aaron Dexter, one of the Vice Presidents of the Society for promoting Agriculture, in the State of Massachusetts, &c. &c. &c.

....

Factory, (Remmon Falls) Derby, Dec. 10th, 1807.

DEAR SIR,

THE importance of rightly understanding the best means of multiplying and improving the fine woolled breed of Sheep, derived from a cross of the pure Merino blood with that of the common flocks of the country, must be my apology for offering a few observations in addition to those which I had the honour of communicating to your Agricultural Society, on the 28th of last month. To facilitate the extension of this improved breed, and to confirm its superior excellence in point of wool, it is conceived, are objects which have a peculiar claim to the public attention.

A mixed breed being first produced from our finest-woolled Ewes by full-blooded Merino Rams, it is still desirable that the Spanish blood should be renewed for three or four generations, through the medium of sires of that race. Then the system of *breeding* IN and IN, as it is technically called, and as it has been ably explained by Dr. Parry, of Bath, in his late " Essay on the nature, produce, origin, and extension of the Merino breed of Sheep," proves decisive for the accomplishment of the objects proposed, in the shortest time, at the smallest expence, and with the greatest certainty, of any other plan hitherto suggested.

It is judged by the farmers in this neighbourhood, who are best acquainted with this confirmed mixed breed, that, aside of their superior excellence with respect to wool, they have a greater tendency to fatten, on the same keeping, than any other Sheep within the compass of their knowledge. Although this disposition to fatten is of little consequence so long as they are bred for the fleece only ; yet it may be well, that those farmers who may hereafter propagate them for the sake of the carcass should not be ignorant of the fact.

From my farther inquiries with regard to the weight of the fleeces of my Merinos, I learn, that they have increased somewhat more than I stated in my letter of the 28th of last month. One of the

Rams born here has produced, this season, seven pounds and five ounces of washed wool. This wool would, it is presumed, be worth one dollar and an half per pound in England. I have the united testimony of all the people engaged in, or acquainted with, its fabrication into cloth, to prove that it has not deteriorated, by reason of its augmented quantity, in any respect whatsoever. I take the liberty of inclosing four more specimens of Cloth. No's 1, 2, 3 were made from the wool of the pure Merinos; and No. 4, from that of the half-blooded race.

I beg you will receive the assurances of the real and great esteem, with which I have the honour to be, dear sir, your most obedient and very humble servant. D. HUMPHREYS.

To the Hon. Dudley A. Tyng, Corresponding Secretary to the Society for promoting Agriculture in the State of Massachusetts.

On the MANAGEMENT *of the* DAIRY, *particularly with respect to the* MAKING *and* CURING *of* BUTTER.

BY J. ANDERSON, L. L. D. F. R. S. &c.

[Extracted from the sixth article in the fifth volume of the Letters and Papers of the Bath Agricultural Society.]

WHEN a dairy is established, the undertaker ought to be fully acquainted with every circumstance respecting the manufacture both of butter and cheese; here it is only proposed to treat of the manufacture of butter. The first thing is to choose cows of a proper sort; among this class of animals it is found by experience, that some kinds give milk of a thicker consistence and richer quality than others. In judging of the value of a cow, it ought rather to be the quantity and the quality of the *cream* produced from the milk in a given time, than the quantity of the milk itself; this is a circumstance of more importance than is generally imagined. The small cows of the Alderney breed afford the richest milk hitherto known; but individual cows in every country, may be found, by a careful selection, that afford much richer milk than others; these, therefore, ought to be searched for with care, and their breed reared with attention, as being peculiarly valuable. In comparing the milk of two cows, to judge of their respective qualities, particular attention must be paid to the time that has elapsed since their calving. To make the cows give abundance of milk, and of a good quality, they must at all times have plenty of food. Grass is the best food yet known for this purpose, and that kind which springs up spontaneously on rich dry soils, is the best of all. If the cows are so much incommoded by the heat as to be prevented from eating through the day, they ought to be taken into cool shades for protection; where, after allowing them a proper time to ruminate, they should be supplied with abundance of green food, fresh cut for the purpose, and given them by hand frequently, fresh and fresh in small quantities, so as to induce them to eat it with pleasure.

Cows, if abundantly fed, should be milked three times a day during the whole of the summer season, in the morning early, at noon, and in the evening just before night fall. If cows are milked only twice in twenty four hours, while they have abundance of succulent food, they will yield a much smaller quantity of milk in the same time, than if they be milked three times. Some attentive observers I have met with, think a cow in these circumstances, will give nearly as much milk at *each* time, if milked three times, as if they were milked only twice. In the choice of persons for milking the cows, great caution should be employed, for if *all* the milk be not thoroughly drawn from a cow when she is milked, a diminution of the quantity gradually takes place, and in a short time the cow becomes dry. In the management of a dairy, the following peculiarities respecting milk ought very particularly to be attended to; some of them are, no doubt, known in part to attentive housewives, but they have never been considered of so much importance as they deserve.

APHORISM I.

Of the milk that is drawn from any cow at one time, that which comes off at the first is always thinner, and of a much worse quality, than that which comes afterwards, and the richness goes on, continually increasing to the very last drop that can be drawn from the udder at that time.

Few persons are ignorant that milk which is taken from the cow last of all at milking, which in this country is called *stroakings,* (here *strippings*) is richer than the rest of the milk; but fewer still are aware of the greatness of the disproportion between the quality of the first and the last drawn milk from the same cow at one milking. From several accurate and important experiments it appears, that the person who, by bad milking of his cows, looses but half a pint of the last milk that might be obtained, looses in fact about as much cream as would be afforded by six or eight pints at the beginning, and looses besides, that part of the cream, which alone can give richness and high flavour to his butter.

APHORISM II.

If milk be put in a dish and allowed to stand till it throws up cream, that portion which rises first to the surface is richer in quality and greater in quantity than what rises in a second equal portion of time.

and the cream that rises in the second interval of time is greater in quantity and richer in quality than what rises in a third equal space of time, and so on, the cream decreases in quantity and declines in quality continually, as long as any rises to the surface.

APHORISM III.

Thick milk always throws up a smaller proportion of the cream it actually contains to the surface, than milk that is thinner, but that cream is of a richer quality; and if water be added to that thick milk, it will afford a considerably greater quantity of cream than it would have done if allowed to remain pure; but its quality is at the same time greatly debased.

APHORISM IV.

Milk, which is put into a bucket or other proper vessel, and carried in it to any considerable distance, so as to be much agitated, and in part cooled before it be put into the milk pans to settle for cream, never throws up so much nor so rich cream as if the same milk had been put into the milk pans directly after it was milked.

In this case, it is believed that the loss of cream will be in proportion to the time that has elapsed and the agitation it has sustained after having been drawn from the cow.

From the above facts the following corollaries seem to be clearly deducible.

1. It is of importance, that the cows should be always milked as near the dairy as possible, and it must be of great advantage in a dairy farm, to have the principal grass fields as near the dairy as possible.

2. The practice of putting the milk of all the cows of a large dairy into one vessel, as it is milked, there to remain till the whole milking be finished,

before any part of it be put into milk pans, seems to be highly injudicious, not only on account of the loss that is sustained by agitation and cooling, but also, as it prevents the owner of the dairy from distinguishing the good from the bad cows milk; a better practice therefore, would be, to have the milk drawn from each cow separately, put into the creaming pans as soon as it is milked, without being mixed with any other. Thus would the careful farmer be able, on all occasions, to observe the particular quality of each individual cow's milk, as well as its quantity, and to know with precision, which of his cows it was his interest to dispose of, and which he ought to keep and breed from.

3. If it be intended to make butter *of a very fine quality*, it would be adviseable in all cases to keep the milk, that is first drawn, separate from that which comes last, as it is obvious, that if this be not done, the quality of the butter will be greatly debased, without much augmenting its quantity. It is also obvious that the quality of the butter will be improved in proportion to the smallness of the proportion of the last drawn milk that is retained, so that those who wish to be singularly nice in this respect will only retain a very small proportion of the last drawn milk.

4. If the *quality* of the butter be the chief object attended to, it will be necessary not only to separate the first from the last drawn milk, but also to take nothing but the cream that is first separated from the best milk, as it is this first rising cream alone that is of the prime quality; the remainder of the milk, which will be still sweet, may be either employed for the purpose of making sweet milk cheeses, or it may be allowed to stand to throw up cream for making butter of an inferior quality.

5. From the above facts, we learn that butter of the *very best possible* quality can only be obtained from a dairy of considerable extent when judiciously managed.

6. From these premises, we are led to draw a conclusion different from the opinion that is commonly entertained on this subject, viz.—That it seems probable that the very best butter can only be with economy made in those dairies where the manufacture of cheese is the principal object.

As but few persons would be willing to purchase the *very best* butter at a price to indemnify the farmer for his trouble, I am satisfied from experience and attentive observation, that if in general about the first drawn *half* of the milk be separated at each milking, and the remainder only be set up for producing cream, and if that milk be allowed to stand to throw up the whole of its cream, even till it begins sensibly to taste sourish, and if that cream be afterwards carefully managed, the butter thus obtained will be of a quality greater superiour to what can usually be obtained at market, and its quantity not considerably less than if the whole of the milk had been treated alike.

No dairy can be managed with profit, unless a place properly adapted for keeping the milk, and for carrying on the different operations of the dairy, be first provided.* The necessary requisites of a good milk house are, that it be cool in summer, and warm in winter, so as to preserve a temperature nearly the same throughout the whole year, and that it be dry, so as to admit of being kept clean and sweet at all times.

From the trials I have made, I have reason to believe that when the heat is from fifty to fifty five

* The author here gives a very particular description of the best contrived milk house or dairy.

degrees on Farenheit's thermometer, the separation of the cream from the milk, which is the most important operation of the dairy, goes forward with the greatest regularity. When the heat exceeds sixty degrees, the operations become difficult and dangerous, and when it falls below the fortieth degree, they can scarcely be carried forward with *any degree* of economy, or propriety.

In winter, should the cold become too great, it might be occasionally dispelled, by placing a barrel full of hot water closely bunged up, upon the table, to remain till cooled. This I prefer to any kind of chaffing dish with burning embers.

The utensils of the dairy, must in general be made of wood. As the acid of milk readily dissolves lead, with which the common earthen vessels are glazed, such vessels should be banished from the dairy.

The creaming dishes (for so I call the vessels in which the milk is placed for throwing up the cream) when properly *cleaned, sweet* and *cool,* are to be filled with the milk as soon after it is drawn from the cow as possible, having been first strained carefully through a close strainer.

These dishes should never exceed three inches in depth, whatever be their other dimensions. As soon as they are filled, they are to be placed on the shelves in the milk house, perfectly undisturbed, till it be judged expedient to separate the cream from them.

In a moderately warm temperature of the air, if very fine butter be intended, it should not be allowed to stand more than six or eight hours ; for ordinary good butter, it may safely stand ten or twelve, or more

It is of great importance to the success of the dairy, that the skimming be well performed, for if any part of the cream be left, the *quantity* of the butter will be diminished; and if any part of the milk be taken, its *quality* will be debased.*

When the cream is obtained, it ought immediately to be put into a vessel by itself, there to be kept till a proper quantity be collected for being made into butter. And no vessel can be better adapted to that purpose than a firm neat made wooden barrel, in size proportioned to the dairy, open at one end, with a lid exactly fitted to close it. In the under part of this vessel, close to the bottom, should be placed a cock and spigot, for drawing off any thin serous part of the milk that may chance to be there generated; for if this is allowed to remain, it injures the cream, and greatly diminishes the richness of the quality of the butter; the inside of the opening should be covered with a bit of gauze netting, to keep back the cream while the serum is allowed to pass, and the barrel should be inclined a little forward, to allow the whole to run off.

The separation of butter from cream, only takes place after the cream has attained a certain degree of acidity. The judicious farmer will therefore allow his cream to remain in the vessel until it has acquired that proper degree of acidity that fits it for being made into butter with great ease, by a very moderate degree of agitation, and by which process only, very fine butter ever can be obtained. How long cream may be thus kept in our climate, without rendering the butter made from it of a bad quality, I cannot say; but it may be kept good for a much longer time than is generally suspected, even a great many weeks.—It is certain that cream which has been kept three or four days in summer is in an excellent condition for being made into butter; from

* The cream should be separated from the edges of the dish, by means of an ivory bladed knife, then carefully drawn towards one side by a skimming dish, and then taken off with great nicety.

three days to seven, may in general be found to be the best time for keeping cream before churning.

I prefer the old fashioned upright *churn*, having a long handle, with a foot to it perforated with holes, as it admits of being better cleaned, and of having the butter more easily separated from the milk than any others.

Where the cream has been duly prepared, the process of butter making is very easy; there is however more nicety required than most persons seem to be aware of; a few *hasty, irregular strokes*, may render the butter of scarcely any value, which, but for this circumstance, would have been of the finest quality. The butter when made, must be immediately separated from the milk, and being put into a clean dish, the inside of which, if of wood, should be well rubbed with common salt. The butter should be pressed and worked with a flat wooden ladle, having a short handle, so as to force out *all* the milk that was lodged in the cavities of the mass. The beating up of the butter by the hand is an indelicate and barbarous practice. If the milk be not entirely taken away, the butter will infallibly spoil in a short time, and if it be much washed, it will become tough and gluey. Some persons employ cold water in this operation; but this practice is not only useless, but also pernicious, because the quality of the butter is thus debased in an astonishing manner. In every part of the foregoing process it is of the utmost importance, that the vessels and every thing else about the dairy, be kept perfectly sweet and clean.

Wooden vessels are the most proper for containing salted butter. Oak is the best wood for the bottom and staves. Broad split hoops are to be preferred to all others.

Iron hoops should be rejected, as the rust of them will in time sink through the wood, and injure the colour of the butter. To season a new vessel for the reception of salted butter, requires great care: It should be filled *frequently* with scalding water, allowing it to remain till it slowly cools. After the butter has been cleaned from the milk, as before directed, it is ready for being salted. Let the vessel be rendered as clean and as sweet as possible, and be rubbed all over in the inside with common salt; and let a little melted butter be run into the cavity between the bottom and the sides at their joining, so as to fill it, and make it every where flush with the bottom and sides: It is then fit to receive the butter. Common salt is almost the only substance hitherto employed for preserving butter. I have found by experience that the following composition is in many respects preferable to it, as it not only preserves the butter more effectually from any taint of rancidity, but makes it look better and taste sweeter and more marrowy, than if the same butter had been cured with common salt alone. The composition is as follows:

Take of sugar one part, of nitre (salt petre) one part, and of the best Spanish great salt, two parts; beat the whole into a fine powder, mix them well together, and put them by for use.

Of this composition, one ounce should be put to every sixteen ounces of butter: Mix this salt thoroughly with the butter; as soon as it has been freed from the milk, and put it, without loss of time, into the vessel prepared to receive it, pressing it so close as to have no air holes, or any kind of cavities within it; smooth the surface, and if you expect it will be more than two days before you add more, cover it close up with a piece of clean linen, and over that a piece of fine linen that has been dipped in melted butter, that is exactly fitted to the edges of the vessel all round, so as to exclude the air as much as possible, without the assistance of any watery brine. When more butter is to be added, remove the coverings, and let the butter be applied close above the former, pressing it down, and smoothing it as before, and so on till the vessel is full. When full, let the two covers be spread over it with the greatest care, and let a little melted butter be poured all round the edges, so as to fill up every cranny, and effectually *exclude the air.* A little salt may then be strewed over the whole, and the cover firmly fixed down, to remain closely shut till opened for use. If this be carefully done, the butter may be kept perfectly sound in this climate for many years.*

It must be remarked that butter cured in this manner, does not taste well till it has stood at least a fortnight after being salted. After that period is elapsed, it eats with a rich marrowy taste that no other butter ever acquires. Butter thus cured, will go well to the East or West Indies.

Butter, in its natural state, contains a considerable proportion of mucous matter, which is more highly putrescible than the pure oily parts of the butter. When it is intended to be exposed to the heat of warm climates, it ought to be freed from that mucilage before it be cured and packed up. To do this, let it be put into a vessel of a proper shape, which should be immersed in another containing water. Let the water be gradually heated till the

* The Epping butter is called the best in England. The farmers ake use of a very innocent colouring matter for their winter and early ring butter, which is the juice of carrots. They take clean and fresh rrots, and grate them fine, and squeeze out the juice through a coarse oth, and mix it with their cream. This gives their butter as fine an pearance as the best June butter, without communicating any taste or ivour.

butter be thoroughly melted: Let it continue in that state for some time, and allow it to settle: The mucous part will fall to the bottom, and the pure oil swim at top. When it cools, it becomes opaque and paler than the original butter, and of a firmer consistence. When this refined butter is become a little stiff, and while it is still somewhat soft, the pure part should be separated from the dregs, and then salted and packed up in the same way as is before directed.

Those who wish to see the subject more fully treated, are referred to the original.

The following part of a course of work to be performed by gardeners, in the month of July, is extracted from MAWE'S *Gardener's Calendar.*

....

JULY.

WORK TO BE DONE IN THE KITCHEN GARDEN.

NOW prepare such pieces of ground as are vacant in order to receive such seeds and plants as are proper to supply the table with necessary productions in autumn and winter: many crops will now require inserting, both by sowing and planting, some for temporary succession, and others more extensive for longer continuance, in full crops for the above mentioned seasons; and should give very diligent attention to have them put in now in proper time, according to the directions for the different sorts under their respective heads.

Planting Savoys and Cabbages.

Get ready, in particular, some good ground, to plant out a principal crop of savoys and winter cabbages.

Let an open spot of ground be chosen for these plants; and let it be properly digged, and immediately put in the plants. Let them be planted in rows two feet asunder, which at this season will be room enough, except for the large kind of cabbages, which should be planted two feet and a half distance each way.—A watering at planting will greatly promote the fresh rooting of all these plants.

Transplant Endive.

Plant out now, to supply the table in autumn, a parcel of the strongest endive.

Endive requires good ground; and if dunged will be additional advantage: let it be regularly digged, and the rough surface raked even; then put in your plants the distance of a foot every way from one another, and water them as soon as planted. In dry weather the waterings must be repeated once in two days, till the plants have taken root.

Sow Endive Seed.

Sow also some endive seed. This sowing is to raise a supply of plants for use the end of autumn, and for the principal winter crop.

Choose principally the green curled kind for the main crop: and may also sow some of the white curled sort, and the large Batavia endive, observing of the green kind particularly, that for the greater certainty of procuring a regular supply all winter of good endive, it will be proper to sow some seed of that sort at two different times this month. Let some, therefore, be sown some time between the first and tenth; and sow the next parcel about the eighteenth or twentieth of the month. Dig for this purpose, a small or moderate compartment of good light ground; directly sow the seed thinly, each sort separate, tread it down regularly, and rake it in with an even hand.

Give occasional watering, in dry weather; this will bring up the plants soon, and they will rise regularly.

Onions.

Sow some onions to stand the winter. This must be done in the last week of the month, and not before.

But the principal sowing is directed in next month; though it is proper to sow a few now, to afford some to draw also in autumn and beginning of winter, and may sow both of the common and the Welch onion; the latter stands the severest frosts.

For this purpose dig a compartment of rich ground, and divide it into beds three feet and a half, or four feet broad. Immediately sow the seed tolerably thick, and let it be trodden down evenly, and then raked in. The plants will soon rise, and will get strength by the first of October, to enable them to resist the winter's cold; when they will be very acceptable both to draw in autumn and winter, and in the month of February, March, and April, to use in sallads, and for other purposes.

Mind, when the plants are come up, to let them be timely weeded, otherwise the weeds, which will rise numerously with the onions, would soon get the start, and destroy the whole crop.

Carrots.

In the first or second week in this month you may sow some carrot seed, to raise some young carrots for the table in autumn and winter.

The carrots raised from this sowing will come into use after September, and will be very fine in October and November, &c. and continue good till the following spring.

Choose an open situation and light ground, which dig a proper depth, and directly, while fresh turned up, let the seed be sown moderately thick, and rake it in evenly.

When the plants are come up an inch or two high, let them be cleared and thinned to six or eight inches distance.

Transplant Celery.

Now is the time to prepare some trenches, in order to plant out a good crop of autumn and winter celery.

Allot, for this crop, an open compartment of the best rich ground, and clear it well from weeds; and then mark out the trenches ten inches or a foot wide, and full two feet asunder; or rather, if good ground, allow two and a half, or three feet distance. Dig out each trench longwise, one spade wide, and a moderate spade deep, or about six or eight inches clear depth, the bottom well loosened; laying the earth that comes out neatly in the spaces between the trenches, equally on both sides, in a regular level order; which serves, in part, in earthing up the celery when of proper growth; then as you proceed, dig and level the bottom of each trench, or previously it would be of much advantage to add some rotten dung, and dig it in only a moderate depth; levelling the earth even for the reception of the plants.

Then draw the plants; choose the strongest, and trim the ends of their roots, and the tops of the long straggling leaves, and then plant them in one row along the middle of each trench, setting the plants five or six inches distant in the row; immediately give some water, and let this be repeated in dry weather until the plants have got root.

Landing-up Celery.

Land or earth up the crop of early celery planted into trenches last month, or in May; break the earth moderately well with a hoe or spade, and trim it up neatly to both sides of the rows of plants, three or four inches high, repeating the earthing at this time about once a week, to have some blanched as early as possible.

Cucumbers for pickling.

Attend also to the cucumber plants which were sown or planted in the natural ground to produce picklers.

Their vines will now begin to advance, and should be laid out in regular order; but, where not done before, it would first be proper, early in the month, to dig and loosen the ground lightly between the holes of plants, not going too near to disturb the roots: and as you proceed, draw some earth between and round the stems of the plants, in each hole, pressing it down gently, in order to make them spread different ways, also to draw the earth up round each hole, to form a bason, to contain the water when given in dry weather, and let the runners of the plants, in advanced growth, be trained out in proper regularity.

These plants must also, in dry weather, be well supplied with water; which, in a very hot season, will be necessary every day.

Gather Seeds.

Gather seeds of all sorts according as they ripen.

Let this be done always in perfect dry weather, cutting or pulling up the stems with the seeds thereon, and dispose them spreadingly in some airy place where the full air and power of the sun have free access, in order to dry and harden the seed in a proper degree; observing to turn them now and then; and when they have lain a few days, or a week, or fortnight, according to the nature of the different sorts, the seed should then be beaten out, and well cleaned from the husks and rubbish, and put up in boxes or bags.

Gathering Herbs for Drying and Distilling.

Gather mint and balm, pennyroyal, sweet-marjoram, as also carduus, hyssop, sage-tops, lavender-spikes, marigold, and chamomile flowers ; and other aromatics which are now advancing towards flowering ; in order to dry, to serve the family in winter.

These kinds of herbs should always be cut for the purpose of drying when they are in the highest perfection, nearly of full growth, and coming into flower ; and some when in full flower ; as lavender, marigold, and chamomile, for their flowers only. Let them be cut in dry weather, and spread or hung up in a dry airy place, out of the reach of the sun, that they may dry gently.

Likewise gather spear-mint, peppermint, pennyroyal, lavender flowers, and other herbs to distil. Many of the proper kinds will now be arrived at full growth, and advancing into flower ; and that is the proper time to cut all such herbs as are intended for the purpose of distilling.

Plant Sage and Savory, &c.

Plant now, as soon as possible, slips of sage where it was omitted in the former months, and also the slips of hyssop, winter savory, lavender, rue, and such like herbs.

Choose such young side-shoots of the branches for slips as are about five, six, or seven inches long, of proper strength ; they must be planted in a shady border, inserting them two thirds of their length into the earth ; give water at planting ; and in dry weather must be often repeated.

Watering.

Watering should at this time be duly practised in dry weather, to all such plants as have been lately planted out, till they have taken root: likewise to seed-beds lately sown, and where small young seedling plants are advancing.

This work should generally, at this season, in sunny weather, be done in a morning, or towards the evening. The proper hours, in a morning, any time between sun-rising and eight or nine o'clock; and between the hours of four and eight, or nine, in an evening; as the watering at these times has greater effect, by the moisture having time to settle gradually into the earth, before much exhaled by the great power of the full mid-day sun.

Clearing the Ground.

Clear the ground now from the stalks and leaves of all such plants as have done bearing.

In particular, clear away the stalks and leaves of the early crop of cauliflowers, and let the ground be hoed and made perfectly clear from all manner of rubbish and weeds.

Likewise pull up the stalks and haulm of such beans and peas as have done bearing, and all such other plants as are past service, clearing away also all decayed leaves of cabbages, artichokes, and all such like rubbish litter, which both appear disagreeable, and afford harbour to noxious vermin; and let all large weeds be at the same time cleared off the ground.

The ground will then appear neat, and will also be ready to dig, in order to be sown or planted with autumn or winter crops.

From the art of destroying Moles after the manner of D'AMIGNAC, by M. DRALET, keeper of the Forests in the vicinage of Toulose.

EVERY one knows how destructive the Mole is to agriculture. This animal lives in the earth, and destroys all the roots it meets with, whilst pursuing the long subterraneous path which he forms with his nose and paws. He delights himself most in gardens, where he makes considerable ravages; but it is in pastures that he does most injury, by covering them with molehills; these not only occupy part of the ground where grass would have grown, but present an obstacle to the scythe in mowing.

Those are the most apparent injuries caused by this destructive animal; but there are others more important, though not so generally observed; they take place in pastures through which are rivers or streams, by destroying the dykes; particularly in the summer when they are seeking for water.

OBSERVATIONS

On the natural history of the Mole, *serving as an introduction to the art of destroying them.*

1st. The mole lives under the surface of the earth; the atmosphere incommodes him.

2d. Notwithstanding this, he sometimes quits his habitation in the ground, in pursuit of one more convenient and which he immediately enters.

3d. He feeds on roots, insects and worms; this is the reason why he is generally found in soft and good lands.

4th. He does not reside either in muddy or in stony ground.

5th. He hastens to get out of his subterraneous residence if water comes in upon him.

6th. During the winter and rainy season, he inhabits high places, because they are not so moist and he is secure from inundations.

7th. In the pleasant season he descends from the hills, mostly into the pastures, where he finds fresh ground, easy to work, and furnished with roots.

8th. When there has been a long drought, he shelters himself along the ditches and streams, and under the hedges.

9th. It is in the months of March, April and May, that the females bring forth the young : there are generally four or five to a litter.

10th. They prepare beforehand a deep hole, with a firm covering, in an elevated spot, protected by a hedge or a clump of trees : there may be seen above this habitation, four or five large mole hills very near to each other.

11th. The mole cannot live without working. Being compelled to seek his food in the bowels of the earth, he makes long subterraneous passages, called burrows.

12th. These burrows are generally parallel to the surface of the earth, from four to six inches deep, according to the season.

13th. As moles are almost equally afraid of heat and cold, it is in winter and summer, that they dig deepest into the earth ; that is, their burrows are then most distant from the surface.

14th. They are very timorous ; when they apprehend that they are in danger, they sink themselves into the earth in a perpendicular burrow, which they sometimes bore to the depth of a foot and a half.

15th. As fast as moles form burrows, they throw out at the surface of the ground the earth which they have detached ; this produces the little risings, called *molehills ;* they make at each attempt, three, four, six, and even nine, according to their age and strength.

16th. From this, it is evident, that the burrows made by one single mole, must have a communication under ground.

17th. *If with any instrument whatever you open a burrow which has been lately made, the mole will in a few moments go to the opening to make such repairs as will keep out the air ; for this purpose he forms at the open place a mound of earth, which externally looks like an oblong molehill, and with this he patches, as it were, the broken burrow.*

18th. *If a fresh molehill is injured, the mole will come and repair it.*

These two last points make the principal base on which the whole art depends.

19th. The mole works in all seasons, for it is only by labour that he procures his food.

20th. It is not true that he sleeps all winter, as some naturalists have pretended, but in that season he has but little activity, and works much less than he does in summer.

21st. It is at the approach of spring that moles are most busy at work, and that they make the greatest number of hills. For this there are several causes : The first is the necessity of providing food for their young, which are born about this time ; the second is the ease with which they can move the earth, and the third is, that as the temperature grows mild, the animal recovers his powers, which were diminished by the severity of the cold.

22d. The male is much more vigorous than the female, and the molehills which he makes are large and numerous.

23d. The female works less than the male ; her hills are smaller and fewer.

24th. The young ones merely form long furrows, throwing up the surface of the ground, which but just serve to cover them; when they begin to make hills they are small, without form, and in zigzag positions.

25th. Their hours for work are, at sunrise, nine o'clock, noon, three o'clock, and at sunset; but it is at sun rise and sunset that they are most ardent at their labour.

26th. In a dry time they seldom make hills, except at sunrise; and in winter they seize the moment when the sun has heated the ground.

27th. It appears that the sense of seeing is hardly possessed by them; but, in return, nature has bestowed on them the most delicate sense of hearing.

28th. They are not easily taken, except when they are at work.

29th. Of course the most favourable time for the *molecatcher* is in the spring (21.)

30th. At this season it is in the pastures that war should be made on them (7.)

31st. They must be attacked at sunrise, at nine o'clock in the morning, at noon, 3 o'clock, or at sunset (25.)

32d. It is better to begin at sunrise than at any other time of the day.

33d. The most convenient hour after this is nine o'clock, because if the whole number of the moles in pursuit are not then taken, the work can be continued at the proper hours of the day.

34th. While watching for them great care should be taken to prevent noise, particularly striking the ground (27.)

35th. Sometimes the mole may be compelled to quit his hole, by pouring in a certain quantity of water (5.)

36th. When any person is near to a molehill, at the time when the mole is blowing, if he cuts with a hoe the passage which communicates with the next hill, and stops it with earth, the mole will be imprisoned between this and the molehill (16.)

37th. A fresh hill proves the presence of a mole; this is also the case when there are several fresh hills at a short distance from each other.

38th. However fresh the hill may be, if it is pierced in the centre, in a perpendicular hole of about two inches diameter, it is certain that the mole has quited the ground, to find one better suited to him (2.)

39th. When a number of fresh hills are discovered, if they are all opened with a hoe, and the boring under ground which communicates from one to the other are searched, the mole will certainly be caught whilst at work.

40th. This operation would undoubtedly be too long and difficult, but it may be made very simple, if the mole can be inclosed between two points not distant from each other; in this case you have only to search the intermediate space between the two points.

41st. The mole may be confined between two points in his burrow, by means of incisions made into it in proper places; these incisions cut off his passage.

42d. When a cutting is made, the openings of the burrow must be slightly shut up with a little earth at each end.

Application of the above named principles, or the practice of the art of destroying Moles.

The only instrument, which is absolutely necessary, is a hoe; but it is convenient to be provided with a little straw, a few pieces of white paper, and a pot of water.

Of the number of Moles which are in an estate—of their sex and age.

The first object is to find out the number of moles existing on the *grounds,* so as to attack them all, as far as possible, at the same time; this is the way to work with effect.

Suppose a pasture to be represented by the annexed engraving, covered with molehills, figures 1, 2, 3, 4, 5, 6, 7.

Figure 1 is an insulated hill; being fresh, it discovers that the mole is near; (37) it is a large one, of course it must be made by a male (22.)

Figure 2. Two hills at a short distance from each other, they must have been made by one mole only; (37) they are fresh, of course the mole is working; they are small, then the mole must be a female (23.)

Figure 3. The three hills are at a short distance from each other, then they must belong to only one mole; they are fresh, then the mole must be working; they are large, then it must be a male.

Figure 4. The six hills are at a short distance one from the other, and must have been made by one mole only; being fresh, the mole must be working; being small, they must belong to a female.

Figure 5 discovers furrows in zigzag, or without plan, and being fresh, they give evidence of a young mole (24.)

Figure 6, five dry hills; of course they are abandoned by the mole.

Figure 7, is seven hills, they are fresh, but one of them, M, is pierced in the top of it; then the mole has quited them within a short time (38.)

From these observations, I am convinced that there is in the pasture two males, two females and one young one.

It is not unimportant to know whether the moles which are pursued are males or females, young or old: The males working fastest (22) must be more closely watched than the females. The young ones only raise the earth at the surface, pass very quick, and must not be left out of sight.

OPERATION.

First case. When a mole makes but one hill, figure 1.

I take off the hill with my hoe, and ascertain whether it has a communication with other neighbouring ones; to do this, I cough, or make a slight noise at the opening made, and at the same time listen: if the hill has no communication, the mole being at a short distance, is frightened at the noise. I hear him moving, he cannot then escape from me.

I open the burrow a b with the hoe and follow it to b where I find the mole.

Perhaps the animal, knowing his danger, has had time to sink himself in the earth by a perpendicular burrow, b c (14) then I have two ways of taking him. I either dig to c, when I find my prey, or I pour in water at b, and the animal comes out of himself.

If, on the contrary, when I cough I do not hear the animal move, this proves that this hill communicates with others, and I operate as in the following cases.

Second case. When the mole has made two hills, A B figure 2.

I make an opening, d e about nine inches long, in the direction of the burrow communicating from one hill to the other; I shut up with a little earth the two extremities d e of the burrow; in a few moments the mole, struck by the air from without, and fearing for his safety, comes to repair the injury made to his dwelling, (17) he blows either at d or e ; if it is at d that he presents himself, I am sure of finding him between this point and the hill A. If it is at e, I am sure that he is between this last point and the hill B. In one or the other of these instances I operate as in the *first case* before mentioned : that is, I uncover that part of the burrow which bounds on the hill A, or on the hill B.

Third case. When the mole has made three hills, C D E figure 3.

I make the openings f g h i. The mole comes to blow at f g h or i ; if he blows at f, he finds himself inclosed between this point and the hill C ; if he blows at i, he finds himself inclosed between this point and the hill E ; if he comes to g or h, he is in the intermediate space between these two points.

In these three instances I operate as in the *first case,* by opening the space in which the mole is discovered.

If he is shut up between g and h and I am not disposed to uncover all this distance, I take off the hill D and make in its place a third common opening. I wait until the mole has blowed, and the side on which he comes indicates to me whether I shall find him between the third incision and the point g, or between this opening and the point h.

Fourth case. When the mole has made four or more hills, figure 4.

Suppose there are six hills, F G H J K L. I make the incision k l. If the mole blows at k, it is inclosed between this point and the hill F. If, on the contrary, it blows at l, it must be inclosed between this last point and the hill L.

In either of these instances I make from K to F or from l to L the operations directed in the *third case.*

Another way of operating in the 2d, 3d and 4th cases, above named.

Suppose that when the cutting d e figure 2. is made, the mole comes to blow at d and that he blows while I am present, I know that he must traverse the space d e to repair his burrow, by forming a mound of earth, which he detaches from the bottom of the opened place. If I stop here without making a noise, I shall see him working, and to catch him it will be only necessary to thrust the handle of my hoe after him before he gets to the point e; by this means the earth which I have been careful in placing at the opening d will prevent his advancing, and the handle of my hoe will keep him from retreating—he can then be easily taken by removing with the hands the little earth with which he is covered.

One may discover the moment when the mole comes to blow, without staying near the opening, by sticking into the ground a straw, at the end of which is fixed a little piece of paper; this little standard will be upset, or at least shaken, at the first movement made by the mole in the place where it is planted, and give the signal to the person watching.

Fifth case. When the mole does not come to blow at the openings made by the operator.

Suppose that after having made the opening k l figure 4, the mole continues to blow at the first hill L then I am sure that he is between the point l and the hill L and the operations must be the same as in *case third;* that is, I must act as if there were only the hills J K L.

To find out whether the mole blows at a hill while I am absent, I flatten it slightly with my foot, and if on my return I find a little rising in it, there can be no doubt but that the mole has been working there.

Sixth case. Another way of operating in the 2d, 3d, 4th and 5th cases above named, when near to the hill at the time when the mole is blowing.

If I find myself near the hill L, figure 4, at the moment when the mole is blowing, I do not use the uncertain means of the gardeners, who take off the hill with a spade, but I make a large opening with my hoe at m n in the burrow communicating to the neighbouring hill K ; this is a sure way of shutting up the mole between the hill L and the point m n.

When he is thus enclosed, I operate as in *case first* ; that is, I uncover the interval in which he is shut out

It is useless to say that to ensure success in this way, the hill where the mole blows must have but only one communication.

Seventh case. When one or more fresh hills are found in the neighbourhood of old hills, figure 4 and 6.

This last case is the most intricate of all—it being doubtful whether the fresh hills communicate by burrows with old ones—however, this may be, it is necessary to make an opening between the old and the new, so that the mole, alarmed in the new, may not escape into the old ones—after this operate, as in the preceeding cases.

When this is the case, it is impossible to make too many openings, if there is no danger of injuring the land, it would be well, for instance, in figures 4 and 6, to make a cutting in the direction from H to N ; and another from H to O because there may be a burrow in one or the other of those directions, and perhaps in both of them.

OBSERVATIONS.

If one person kept closely watching only one mole, without directing his attention to others, he would destroy but very few in the course of a day—But in searching an estate, to find out the number of moles which infest it, it is necessary to flatten slightly with the foot all the new hills, and to make all the openings in the burrows, without being afraid to make too many where the ground will permit. The little standards before named, must be planted, then the operator may go from one mole to another.

In attacking a number of moles at the same time, great vigilance and activity are required, lest, whilst watching the one, the others should have time to repair their burrows.

The mole will require more time to repair an opening, if a little mound of earth is placed at the bottom of it, and this is often a very good precaution.

THE END

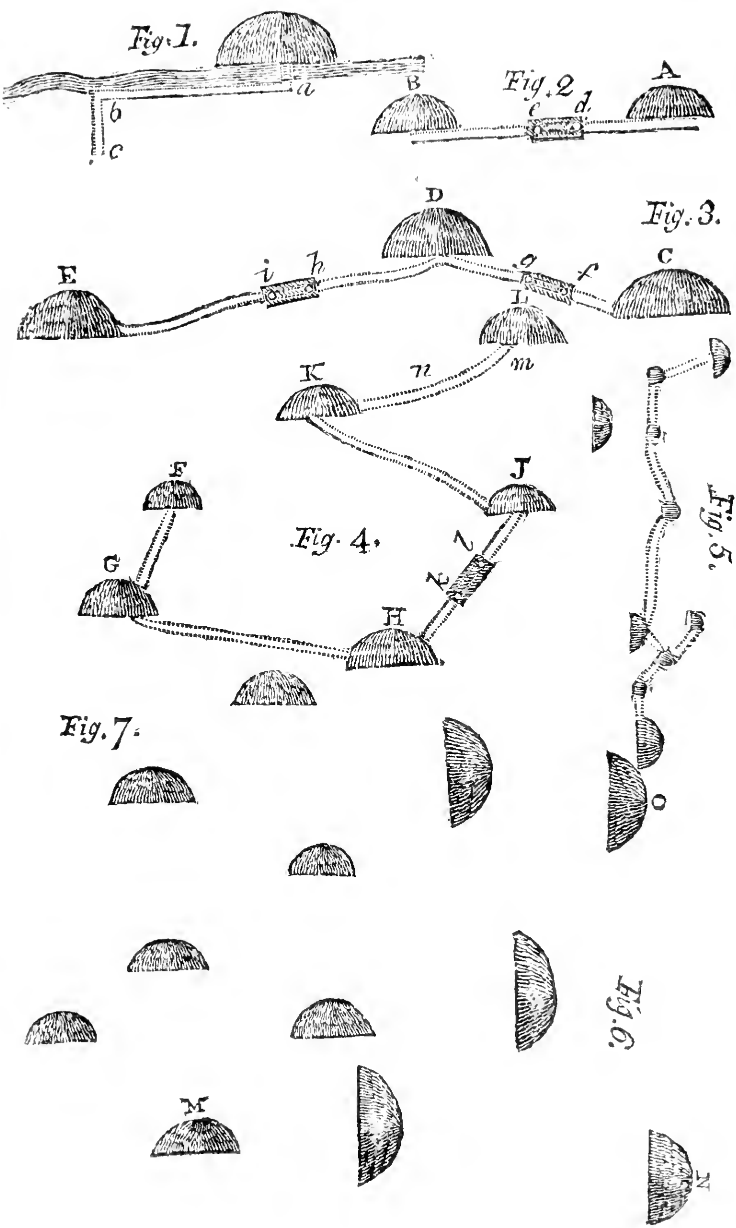
Fig. 1.
a
b
c
Fig. 2
A
B
c
d.
Fig. 3.
D
C
E
i
h
g
f
L
n
m
K
Fig. 4.
F
G
H
J
l
k
Fig. 5.
Fig. 7.
O
Fig. 6.
M
N