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TREATISE

ON

AGRICULTURE;

COMPRISING

A CONCISE HISTORY OF ITS ORIGIN AND PROGRESS,

THE PRESENT

CONDITION OF THE ART,

ABROAD AND AT HOME,

AND THE

Theory and Practice of Husbandry,

WHICH HAVE ARISEN OUT OF THE PRESENT STATE OF
PHILOSOPHICAL ATTAINMENTS IN EUROPE.

—*—

BY A PRACTICAL FARMER.

ALBANY:

PRINTED BY J. BUEL,

And for sale at the Bookstores in Albany; by *Wiley & Co.*, New-York; *W. Williams*, Utica; *J. Bogert*, Geneva; *J. D. Bemis & Co.*, Canandaigua; *T. M. Skinner*, Auburn; *A. Childs*, Johnstown; *S. H. Salisbury*, Buffalo; *U. C. Lewis*, Newburgh; *W. S. Parker*, Troy; *P. Potter*, Poughkeepsie; *J. S. Lewis*, Catskill; *W. E. Norman*, Hudson.

Prose dated 1819 -

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TREATISE

Southern District of New-York.

 * L. S. *
 * *****
 BE it remembered, that on the second day of December, in the 44th
 year of the Independence of the United States of America, JESSÉ
 BURL, of the said district, hath deposited in this office the title of a book,
 the right whereof he claims as proprietor, in the words following, to wit: "A TREA-
 TISE ON AGRICULTURE; comprising a Concise History of its Origin and Progress,
 the Present Condition of the Art, abroad and at home, and the Theory and Practice
 of Husbandry, which have arisen out of the Present State of Philosophical Attain-
 ments in Europe—by a PRACTICAL FARMER."

In conformity to the act of congress of the United States, entitled "An act for the encouragement of Learning, by securing the copies of Maps, Charts and Books, to the authors and proprietors of such copies, during the time therein mentioned, and extending the benefits thereof to the arts of designing, engraving and etching historical and other prints."

GILBERT LIVINGSTON THOMPSON,
Clerk of the Southern District of New-York.

ALBANY:

PRINTED BY J. BAKER.

[illegible]

BOARD OF AGRICULTURE.

IN GENERAL COMMITTEE, *January 24, 1820.*

The committee appointed to examine the "Treatise" offered to the Board of Agriculture, by Mr. Buel, and to consider his proposition for the purchase of a certain number of copies, report—

THAT they have examined the Treatise, and recommend to the General Committee to avail themselves of the very valuable materials contained in it, in order to diffuse a more general knowledge of the principles of husbandry.

The committee consider this "Treatise," as comprehending a very enlarged view of all the relations of Agriculture, and to be every way worthy of the public attention.

That the proposal of Mr. Buel to the General Committee, to purchase 1000 copies of the "treatise," cannot be acceded to, at this time, as the funds at the disposal of the Committee, are inadequate to that purpose.

STEPHEN VAN RENSSELAER, *Chairman.*

Thereupon,

Resolved, That the report be accepted.

(A Copy.)

S. SOUTHWICK, *Secretary.*

If my opinion can be supposed to add the smallest weight to such respectable evidence of the utility of the Treatise you are about to publish, I can assure you, that on a deliberate review of it, I am satisfied, that it ought to be purchased by every farmer who wishes to avail himself of the best information to be obtained in relation to the art upon which he depends for subsistence.

Wishing you all the success the utility of your enterprise deserves,

I am, Sir,

Your very ob't. serv't.

S. SOUTHWICK.

J. BUEL,

PREFACE.

THE following Treatise, written in the pauses of private business, first appeared in the Albany Argus, during the present year. The partiality with which it was then received, has induced the editor of that paper, to give it to the public in a less perishable form.

The principal object of the writer was to contribute his aid, in giving to the practice and study of Agriculture, a new and increased impulse throughout the state; and he supposed this could be best done by exhibiting, concisely, the origin and progress of the art, its present condition abroad and at home, and lastly, the theory and practice, in relation to it, which have arisen out of the present state of philosophical attainments in Europe. In executing the work, his principal care has been to offer only established facts and useful opinions; and if, by these means, he has succeeded in reducing the contents of many heavy volumes, into a single and small octavo, he has entirely fulfilled his own expectations, and probably not disappointed the wishes of his readers.

THE AUTHOR.

December, 1819.

CONTENTS.

	<i>Page.</i>
<i>Sec. I. Of the rise and progress of Agriculture,</i>	7
<i>II. Of the actual state of Agriculture in Europe,</i>	11
<i>III. Theory of Vegetation, - - -</i>	33
<i>IV. Of the analysis of Soils, and the agricultural relations between Soils and Plants,</i>	49
<i>V. Of practical agriculture and its necessary implements, - - - - -</i>	55
<i>VI. Of Manures—their management and application, - - - - -</i>	62
<i>VII. Of Tillage, and the principles on which it is founded, - - - - -</i>	74
<i>VIII. Of a Rotation of Crops, and the principles on which it is founded, - - -</i>	79
<i>IX. Of the plants recommended for a course of crops, (in the preceding section) and their culture, - - - - -</i>	86
<i>X. Of other plants useful in a rotation of crops, and adapted to our climate,</i>	118
<i>XI. Of Meadows, - - - - -</i>	126
<i>XII. Of Orchards, - - - - -</i>	137
<i>XIII. Of Farm Cattle, - - - - -</i>	147
<i>XIV. Of the Dairy, - - - - -</i>	159

THE

CONTENTS

OF THE

THE	1
THE	2
THE	3
THE	4
THE	5
THE	6
THE	7
THE	8
THE	9
THE	10
THE	11
THE	12
THE	13
THE	14
THE	15
THE	16
THE	17
THE	18
THE	19
THE	20
THE	21
THE	22
THE	23
THE	24
THE	25
THE	26
THE	27
THE	28
THE	29
THE	30
THE	31
THE	32
THE	33
THE	34
THE	35
THE	36
THE	37
THE	38
THE	39
THE	40
THE	41
THE	42
THE	43
THE	44
THE	45
THE	46
THE	47
THE	48
THE	49
THE	50
THE	51
THE	52
THE	53
THE	54
THE	55
THE	56
THE	57
THE	58
THE	59
THE	60
THE	61
THE	62
THE	63
THE	64
THE	65
THE	66
THE	67
THE	68
THE	69
THE	70
THE	71
THE	72
THE	73
THE	74
THE	75
THE	76
THE	77
THE	78
THE	79
THE	80
THE	81
THE	82
THE	83
THE	84
THE	85
THE	86
THE	87
THE	88
THE	89
THE	90
THE	91
THE	92
THE	93
THE	94
THE	95
THE	96
THE	97
THE	98
THE	99
THE	100

TREATISE

AGRICULTURE.

SECTION I.

Of the Rise and Progress of Agriculture.

THE origin of this art is lost among the fables of antiquity, and we have to regret, that in the present state of knowledge, we are even ignorant of the *time* when the plough was invented, and of the *name* and *condition* of the inventor. (1) When therefore we speak of the beginning of the art, we but allude to certain appearances which indicate its existence, and the employment given by it to the minds, as well as to the hands, of mankind. Such were the artificial canals and lakes of Egypt. Menaced at one time by a redundancy of water, and at another by its scarcity or want, the genius of that very extraordinary people could not but employ itself, promptly and strenuously, in remedying these evils, and eventually, in converting them into benefits; and hence it was, that when other parts of the world exhibited little more of agricultural knowledge than appertains to the state of nature, imagined by philosophers, the Egyptians thoroughly understood and skilfully practised *irrigation*, that most scientific and profitable branch of the

(1) This invention has been attributed to *Osiris*.—See Millet's *Gen. Hist*

art. (1) Like their own Nile, their population had its overflow, which colonised Carthage and Greece, and carried with it the talent and intelligence of the mother country. The former of these states, though essentially commercial, had its *plantations*, and so highly prized were the agricultural works of Mago, that when Carthage was captured, they alone, of the many books found in it, were retained and translated by the Romans. A similar inference may be drawn from the history of Greece; for assuredly that art could not have been either unknown or neglected, which so long employed the pen and the tongue of the great Xenophon. (2) It must however be admitted, that of the ancient nations, it is only among the Romans, that we find real and multiplied evidences of the progress of the art; *facts*, substituted for *conjectures* and *inferences*. Cato, Varro, Columella, Virgil and Pliny, wrote on the subject, and it is from their works we derive the following brief exposition of Roman husbandry.

The plough, the great instrument of agricultural labor, was well known and generally used among them; it was drawn exclusively by horned cattle. Of *fossile manures*, we know that they used *lime* and probably *marle*, (3) and that those of animal and vegetable basis, were carefully collected. Attention to this subject, made part of the national religion;

(1) The best practical illustration of this opinion is found in the valley of the Po—where “every rood of earth maintains its man.”

(2) Xenophon wrote several treatises on husbandry and gave public lectures on it at Scyllonte, whither a weak and wicked government had banished him.

(3) For the first part of this assertion we have the authority of Pliny; for the latter, the practice of their colonies both in Gaul and Britain.

the dunghill had its god, and *Stercutus*, his temple and worshippers. Their corn crops were abundant; besides *barley* and *far*, (1) they had three species of *wheat*; the *robust* or red—the *siligo* or white—and the *triticum trimestre*, or summer wheat; they had, besides, millet, panis, zea and rye, all of which, producing a flour convertible into bread, were known by the common name of *frumentum*. Leguminous crops were frequent; the lupin in particular was raised in abundance, and besides being employed as a manure, (2) entered extensively into the subsistence of men, cattle and poultry. The cultivation of garden vegetables was well understood and employed many hands; and meadows, natural and artificial, were brought to great perfection. Lucern and fenu-gree were the basis of the latter, and peas, rye and a mixture of barley, beans and peas, called *farrago*, were occasionally used in the stables as green food. Their flocks were abundant, and formed their first representative of wealth, as is sufficiently indicated by their word *pecunia*. Vines and olives and their products (wine and oil) had a full share of attention and use. The rearing of poultry made an important part of domestic economy, nor were apiaries and fish ponds forgotten or neglected.

Such was the husbandry of Rome, when Rome was mistress of the world, and it was to this illustrious period that Pliny alluded when (speaking of the

(1) Of this last, there were three kinds, neither of which is now cultivated.

(2) The *lupinus albus* of Linneus: "many other vegetables are used for this purpose, particularly the *bean*, but do not answer as well as the *lupin*; when this is heated in an oven and then buried, it forms the most powerful of all manures." T. C. L. Simonde. *Tableau de L'agriculture Toscane*.

ancient fertility of the soil) he remarked, "that the earth took pleasure in being cultivated by the hands of men, crowned with laurels and decorated with triumphal honors."

If we pause for a moment, to glance at the civil institutions of this wonderful people, we discover how soon and how deeply it entered into their policy, not merely to promote, but to dignify agriculture and its professors. (1) When Cicero said, that "nothing, in this world, was better, more useful, more agreeable, more worthy of a free man, than agriculture;" (2) he pronounced, not merely his own opinion, but the public judgment of his age and nation. Were troops to be raised for the defence of the republic? The *tribus rusticus* was the privileged nursery of the legion! (3) Did exigencies of state require a general or dictator? he was taken from the *plough*! Were his services rewarded? this was done not with ribbons or gold, but by a donation of *land*. (4)

With such support from public opinion, it was not to be supposed, that the laws would be either adverse, or indifferent to this branch of industry; we accordingly find the utmost security given to the labors of the husbandman; (5) no legislative interposition between the seller and buyer; neither forced sales nor limitation of prices, and a sacredness of boundaries never disturbed; (6) fairs and markets

(1) Tannus and Numa were deified for services rendered to agriculture.

(2) Cicero de officiis. L. 2.

(3) This continued till the time of Marius.

(4) As much as he could plough in a day.

(5) To cut or destroy in the night the crop of his neighbor subjected the Roman to death.

(6) Terminus was among their gods,

multiplied and protected against invasion or interruption, (1) and highways leading to these, every where established, and of a character to call forth benediction and admiration. (2)

Nor were these regulations confined to the proper territory of Rome ; what of her own policy was good, she communicated to her neighbors ; what of their's was better, she adopted and practised herself. Her arts and arms were therefore constant companions : wherever her legions marched, her knowledge, practices and implements followed ; and it is to these we are to look for the foundation of modern agriculture in Italy, France, Spain, &c.

SECTION II.

Of the Actual State of Agriculture in Europe.

THIS is very different in different states, and even in different parts of the same state : its greater or less degree of perfection, depending on causes physical, or political, or both. Where a state, or part of a state, from *soil, climate, manners, or geographical position*, draws its principal subsistence from the fishery or the chase, as in the more northern parts of Europe, agriculture will not succeed ; when a state is from any cause both essentially maritime or manufac-

(1) Assemblies of the people on days designated for fairs, and on subjects other than those of trade, were not lawful.

(2) The Appian way, yet remains the wonder and reproach of modern times.

turing, as in England, or principally manufacturing, as in Prussia; where public opinion has degraded manual labor, as in Spain, Portugal, and the Papal territory; or where laws villainize it, as in Russia, Prussia, Poland, Hungary, &c. &c. it is in vain to expect pre-eminent agriculture. These principles will receive illustration as we go along.

I. In the Campania of Rome, where in the time of Pliny were counted twenty-three cities, the traveller is now astonished and depressed at the silence and desolation that surround him. Even from Rome to Trescati, [four leagues of road the most frequented] we find only an arid plain, without trees, without meadows, natural or artificial, and without villages, or other habitation of man! Yet is this wretchedness not the fault of soil or climate, which (with little alteration) (1) continue to be what they were in the days of Augustus. "*Man is the only growth that dwindles here,*" and to his deficient or ill directed industry, are owing all the calamities of the scene. (2) Instead of the hardy and masculine labors of the field, the successors of Cato and of Pliny employ themselves in fabricating *sacred vases, hair powder and pomatums, artificial pearls, fiddle strings, embroidered gloves and religious relics!* They are also great collectors of pictures, statues and medals — "*dirty gods and coins,*" and find an ample reward in the ignorance and credulity of those who buy them.

(1) The climate of Italy is now warmer than it was in the Augustan age, which Buffon ascribes to the draining of great tracts of swampy land in Germany.

(2) "Un Romain meme le plus indigent rougiroit de cultiver la terre." Bosc.

II. How different from this picture is that of *Tuscany* ! where the soil, though less fertile (1) is covered with grain, with vines and with cattle ; and where a surface of 1200 square leagues, subsists a population of 950,000 inhabitants, of which 80,000 are agriculturists. It may amuse, if it does not instruct, the reader, to offer a few details of a husbandry, among the most distinguished of the present age. The plough of north Europe, like that of this country, has the power of a wedge, and acts horizontally—that of Tuscany has the same direction, but very different form. With the outline of a shovel, it consists of two inclined planes, sloping from the center, and forming a gutter and two ridges. This instrument is particularly adapted to the loose and friable texture of the soil. A second plough, of the same shape, but of smaller size, follows that already described, and with the aid of the hoe and the spade (2) throws the earth, already broken and pulverised, into four feet ridges, or beds, on which the crop is sown. The furrows answer a threefold purpose ; they drain the beds of excessive moisture, ventilate the growing crops and supply paths for the weeders.

The *rotation of crops*, employs two periods of different length ; the one of three, the other of five

(1) " Two thirds of Tuscany consists of mountains." Vol. viii. p. 232. *Geographie Mathematique et physique* : See also Forsyth's remarks, p. 80, where are detailed the principal causes of her prosperity. " Leopold," says he, " in selling the crown lands, studiously *divided large tracts* of rich but neglected land, into *small properties*. His favorite plan of encouraging agriculture consisted, not in *boards, societies and premiums*, but in giving *the laborer a security and interest in the soil*—in multiplying small freeholds—in extending the *livelli* or life leases," &c. &c.

(2) It is among the most important covenants of a Tuscan lease, that one third of the ground be actually worked with a spade.

years. In the rotation of *three* years, the ground is sown five times, and in that of four years, seven times, as follows :

- 1st year, wheat, and after wheat lupins :
- 2d do. wheat, and after wheat turnips :
- 3d do. Indian corn or millet.
- 1st year, wheat, and after wheat beans :
- 2d do. wheat, and after wheat lupins :
- 3d do. wheat, and after wheat lupinella: [annual clover.]
- 4th do. Indian corn or millet.

In the *Syanese Maremma*, where the lands want neither repose or manure, the constant alternation is *hemp* and *wheat*, and the produce of the latter often twenty-four bushels threshed for one sown.

It will be seen from this course of crops, that the principal object of Tuscan agriculture, is wheat; of which they have two species, the one bald, the other bearded; both larger than the corresponding species in other countries of Europe; convertible into excellent bread and pastes, and probably but varieties of that *Sicilian family*, which Pliny describes, as yielding "*most flour and least bran, and suffering no degradation from time.*" It is harvested about the middle of June, and when the grain crop is secured, the ploughing for the second, or forage crop, begins, which besides lupins, lupinella and beans, often consists of a mixture of lupins, turnips and flax. The lupins ripen first and are gathered in autumn; the turnips are drawn in the winter and the flax in the spring.

Besides the application of *ordinary manures*, the

lupin is ploughed down, *when in flower*; a practice that began with the Romans: Columella says, "of all leguminous vegetables, the *lupin* is that which most merits attention, because it costs least, employs least time and furnishes an *excellent manure*." The culture of this vegetable is different, according to the purposes for which it is raised; if for grain, the ground has two ploughings and twenty-five pounds weight of seed to a square of a hundred toises: if for manure, one ploughing is sufficient. Like our buck-wheat, its vegetation is quick and its growth rapid; whence the further advantage of suppressing, and even of destroying, the weeds that would have infested any other crop. In the neighborhood of Florence, they are in the practice of *burning the soil*; which they do by digging holes, filling them with faggots and raising the earth into mounds over them. The faggots are then inflamed and burnt, and with them the incumbent earth, which is afterwards scattered, so as to give to the whole field the same preparation.

III. "The countries," says Arthur Young, "the most rich and flourishing of Europe, in proportion to their extent, are probably *Piedmont* and the *Milanese*. We there meet all the signs of prosperity—an active and well conditioned population, great exportations, considerable interior consumption, superb roads, many opulent towns, a ready and abundant circulation, the interest of money low, the price of labor high; in one word, it is impossible to cite a single fact that shows that Manchester, Birmingham, Rouen, and Lyons, are in a condition equally prosperous, as the

whole of these Dutchies." Their population is stated at " 1,114,000, and the territory at little more than two millions of arpens, [acres.] Wheat, rye, Indian corn, flax and hemp, the vine and the olive, the caper and the cotton tree, with all kinds of garden fruits and vegetables, are cultivated here: the soil knows no repose, and much of it yields annually and uniformly two crops of grain or three of grass." (1) These are the miracles of irrigation; not a drop of water is lost. Besides the permanent supplies furnished from lakes, ponds, rivers, creeks and springs, even the winter torrent and summer shower, are every where intercepted by drains and led to reservoirs; whence they are distributed at will to the neighboring grounds.

In 1770, an agricultural school was established at Milan, consisting of 220 boys, who were instructed in theoretical and practical husbandry. This institution has escaped the notice of travellers; and we are unable to say whether it has, or has not fulfilled the intentions of its projectors.

IV. *Switzerland* has 1444 square leagues of surface, and presents an assemblage of mountains, one rising above another, until the summits are lost in masses of snow and ice, which never melt. This short description sufficiently indicates the character of both the soil and the climate; yet unpropitious as these are, we find a population of 1242 inhabitants to each square league! " This is perhaps the country of the world which presents the most happy ef-

(1) Geographic Mathématique, &c. Article Italie.

fects of an industry always active and persevering. The traveller who climbs her mountains is struck with admiration when he beholds vineyards and rich pastures in those places which before appeared naked and barren rocks. The traces of the plough are perceived on the border of precipices, where the most savage animals do not pass without danger ; in one word, the inhabitants appear to have conquered all obstacles, whether arising from soil, position or climate, and to have drawn abundance from a territory condemned by nature to perpetual sterility.”(1.)

V. The classical reader will remember, that *Spain* was the garden of the Hesperides of the Roman writers ; by which was meant the combinations of a fine climate, a rich soil and an active and intelligent agriculture. To this state of things, even the empire of the Goths was not fatal,(2) and that of the Moors rendered it still more distinguished. In their hands, the plains of Valentia were cultivated throughout, with the utmost care and skill ; and where their wheels, reservoirs, and drains of irrigation yet remain, the soil continues to yield the richest and most abundant products. In Catalonia, Navarre, Galitia and the Asturias, many species of the ancient agriculture are yet in vigor, because “ the *leases are long*, and the *landlord cannot capriciously violate them*.” The same causes are followed by the same effects,

(1) Idem. Article Helvetia.

(2) It appears from Varro *De re rustica* and the letters of Cassiodorus, that the Goths introduced into Spain the subterranean granaries called *Sillos*, and the art of *irrigation*. The former are now exclusively used in Tuscany, and Cato's precept, ‘*Prata irrigua*,’ &c. shews whence their knowledge of the latter was derived.

in the three districts of Biscaya, Guiposcoa, and Alava. "In running over these, every thing one finds is animated by the presence of liberty and industry; nothing can be more charming than the coasts, nothing more attractive than the culture of the valleys. Throughout the thirty leagues that separate Bedassos from Vittoria, every quarter of an hour we discover some well-built village, or comfortable cottage."(1)

How different is the aspect of the other provinces! In these, not more than two third of the earth are cultivated, and "it is not uncommon to travel eight and ten leagues together, without finding a trace of human industry. In the district of Badejoz alone, is a desert twenty-six leagues in length and twelve in breadth.(2) Ten of the fourteen leagues that traverse the dutchy of Medina Sidonia, consist altogether of pasturage. There is no where a vestige of man; not an orchard, not a garden, not a ditch, not a cottage to be seen! The great proprietor appears to reign, like the lion in the desert, repulsing by his roaring all who would approach him. But, instead of human colonies, we encounter troops of horned cattle and of *marcs*, wandering, self-directed, over plains to which the eye can discover no boundary or barrier, and which brings to one's recollection the days when the beasts shared with man the empire of the earth."(3)

(1) Burgoing's modern Spain, vol. i.

(2) Borde's Iteneraire de l'Espagne, vol. iv. p. 30.

(3) Burgoing. Spain has been long renowned for its horses. The Romans in settling their pedigree and illustrating their swiftness, called them '*the children of the winds.*'

“Even when the plough is used, it is little more than a great knife fastened to a stick, that just scratches the surface. The grain is threshed by horses, or mules, driven over it, or by means of a plank studded with nails or flint stones and drawn across it.(1) With even this miserable culture, the land in Andalusia yields considerable crops; yet are the inhabitants too lazy or too few to gather them together.(2) This is done by Galiegos, who are the laborers of Spain.” We need scarcely remark, that in a state of agriculture like this, the peasantry cannot be either well fed or well clothed. “The mountaineers live principally upon roasted acorns and goat’s milk, and those of the plain [from Barcelona to Malaga] on bread steeped with oil and occasionally seasoned with vinegar.”(3)

It is wide of our subject to examine the causes of the degradation of character, which marks the agriculture of Spain. Well informed writers have ascribed it to the expulsion of the Moors and Jews, to the weight of taxes and imposts, to the *mesta* or common right of pasturage, to the discovery of America and its consequences, to the effect of climate and the ill-judged charity of bishops and convents, but princi-

(1, 2, 3) Swinburne’s Travels, vol. i. A Spanish peasant, who has earned or begged enough for the wants of the day, will refuse to earn more, even by running an errand. Striking as this fact is, it does not so well illustrate Spanish indolence as the following anecdote from the same pen. In the great sedition at Madrid, which ended in the defeat of the king and the disgrace of his minister (the Marquis des Squillas,) and in its most fervid moments, both parties retired about dinner time to take their *nap* or *meridiana*, after which they returned to the combat with new vigor and enraged fury. If *habits* can thus control the *passions*, to what important uses might not a wise legislation turn them?

pally to the great *manorial grants* and *unequal division* of the soil, which followed the conquest. "We often find six, eight, ten, and even fifteen leagues of extent belonging to one master. The nobility and clergy possess nearly the whole country. One third of Spain belongs to the families of Medina, Celi, D'Alba, De l'Infatado, D'Aceda, and to the archbishops, bishops and chapters of Toledo, Compostella, Valentia, Seville and Murcia. A great proportion of these lands remain untilled and untenanted, and those which are let in *Cortijo* or farms are double or treble the quantity that can be occupied in tillage." (1)

VI. The agriculture of *Portugal* has been subjected to the same evils as that of Spain, to which may be superadded, her connexion with Great Britain; under whose policy she has become a raiser of *fruit*, instead of *grain*.

VII. *France* is probably the country of Europe, which most unites the great desiderata of an extended and profitable agriculture, fertility of soil, mildness of climate, a dense population, an enlightened government, and facility of exportation. Within her ancient limits, she boasts a surface of more than one hundred and fifteen millions of arpens, and a population of twenty-two millions of inhabitants. The following tables will show, in a compressed form, the nature of her soil and the uses to which it is put: (2)

(1) Le Borde's *Iteneraire D'Espace*, vol. i.

(2) See *Geographique*, &c. vol. vi. Art. *France*, p. 13. and Young's tour through France.

GEOLOGICAL TABLE.

	<i>Arpens or Acres.</i>
Alluvial and other rich soil,	26,159,340
Chalky do	13,268,911
Gravelly do	3,261,826
Stony do	18,128,660
Sandy do	7,553,956
Substratum of clay with a slight covering of sand—called <i>landes</i> ,	21,879,120
Granitic and other mountains,	25,261,946

AGRICULTURAL TABLE.

Arable land, - - - - -	63,600,000
Vineyards, - - - - -	4,764,960
Woods, - - - - -	15,931,850
Natural meadows, - - - - -	5,464,800
Artificial meadows, - - - - -	6,332,100
Lakes, marshes, wastes, - - - - -	19,400,049

Total, 115,493,759

From the average of a number of statistical tables made by the Abbe D'Expillyt and others, it appears that in 1777, the agriculture of France was sufficient for the subsistence of its inhabitants, and had a surplus to spare ;(1) and though it be universally admitted that her condition in this respect is not less prosperous *now* than it was *then*,(2) still it cannot

(1) The products of agricultural labour were, in these tables, stated at 114,552,000 L. T. Those of manufacturing labor at 128,015,000.

(2) The effects of the revolution of 1789 on *agriculture*, are no longer doubtful. The suppression of *tythes*—of the *exclusive privilege*—of the *chacc*—of every species

be dissembled that her husbandry has many defects :

1. A supposed resemblance between the earth and animals, gave rise to *fallows* : because men and horses required repose after *labor*, it was supposed that after *cropping*, the earth also required it. Faithful to this absurd analogy, the French landlord binds down his tenant by lease, not to crop the soil more than *three* years out of *four*, which in effect is to consign to barrenness or weeds one fourth of the whole arable land of France yearly !

2. There is not a sufficiently fixed, or steady proportion, between *arable* and *pasture* land. The production of grain is the great object of culture—often with too little regard to the nature of the soil, and generally without any to its improvements. “Where pasturage is scanty, where natural meadows are bad, where artificial are rare, and root husbandry little extended, cattle cannot be either numerous or well conditioned ; and as without these there can be no manure, so without manure there can be no abundance.”(1)

3. The land is generally worked by *farmers*, *hired for that purpose*, or by *renters on short leases* ; which in neither case betters the condition of the soil ; the one having no interest in improvements, and the

of *corvee*, (labor performed by tenants for landlords)—of *taxes* or *rents*, and of *rights of commonage*—was among these effects ; and if to these we add the *division* of the *great landed estates of the nobility and clergy*, there can no longer be any scepticism on this point. No truth is better established than the advantage of *small farms* over *great*, so far as the *public* is concerned. The Roman *latifundia* (military grants) destroyed Roman agriculture.

(1) Herbin's *Statistique general de la France*, vol. i. introduction.

other too small a one to justify any expense in making them.

4. A good rotation system, adapted to the soil and climate, is not absolutely unknown, and may be found even in whole districts (as in French Flanders) but much too rarely. We have seen *wheat* and *fallows* alternating for years; and *wheat*, *rye*, *hemp* and *rye*, and many others equally ridiculous.

5. To the eye, more than one half of France is a common, without fences of any kind, excepting garden or park walls. Can there be order, economy and security, under such circumstances? Can the *police* and the *gens d'armes* be sufficient substitutes?

VIII. *Holland*, though essentially commercial, has from causes rarely occurring, become also highly agricultural. To the descendants of Dutchmen, the following description of her industry, in this respect, cannot but be acceptable. It is from the pen of an excellent judge and faithful narrator (1)

“ Their rotation of crops, always begins with the culture either of some leguminous plant or profitable root, and generally with the potatoe, as the best preparative of the ground. Whatever may be the grain which follows, whether wheat, rye, &c. &c. it is generally sown with *red clover*; and where it is not, the stubble is ploughed in immediately after harvest, and a crop of turnips taken, and either consumed on the ground or housed for the winter. A single department (that of Zealand) obtains by the culture of

(1) M. Yvart, professor of agriculture at Elfort. See his introductory address to his class in 1806.

madder alone, an annual profit of six millions of florins; while that of Brabant boasts its twenty thousand bee hives; in a word, this commendable nation, upon an extent of surface not exceeding seventeen hundred square leagues, (the greater part of which has been redeemed from the ocean) counts two hundred and forty-three thousand horses, seven hundred and sixty thousand horn cattle, about a million of sheep, from ten to twelve thousand goats, four hundred and eighty-nine thousand hogs, and about three millions of poultry, of every species. Their stock of manure is necessarily great, and is both well understood and well managed."

IX. The same causes, physical and moral, operate against the existence of a productive agriculture in *Denmark* and *Sweden*—severity of climate, poverty of soil, and vassalage of tenants. (1) Their resources are also alike, and exist principally in manufactures and commerce, and in mines, forests and fisheries. The former boasts fine pasturage and cattle in Holstein.

X. Under the common name of Germany, we include Prussia, Saxony, Austria, Wurtemberg and Bavaria, and shall say a few words of each, calculated to give a general idea of their husbandry. It was not to be expected that the great Frederick of *Prussia* (so devoted to national glory and strength) would disregard the interests of agriculture; and the less so, as in theory he considered it "*Les mamelles de*

(1) To give to despotism the air of freedom, the *serfs of the crown* were liberated at the revolution—but the example was neither approved nor followed.

pelat." We accordingly find him employed in draining marshes of great extent, (1) in filling them with industrious colonists, and in converting barren sands into fertile fields, by placing his capital in the midst of them. But amongst these good works, he forgot that the *hands of the laborer, to be efficient, must be free*; he found the peasants slaves, and left them such.

"The *Saxon* peasant, on the other hand, is *free*, and protected by the laws; he holds his farm on lease, which he sells or transmits to his children at will: and *this* is the principal cause of the flourishing state of *Saxon* agriculture. In *Lusatia*, a different legislation produces different effects; but for some years past, the government and great proprietors have concurred in changing the *vassalage* of the peasants into a *mild and salutary dependence*. *Saxony* is remarkable for its grain products, and *Lusatia* for its stock—the latter counts four hundred thousand head of sheep of the *Merino* race.

Geographers give to *Austria* and her dependencies 1065 leagues in circumference. In a surface like this, there is necessarily a great variety, as well of climate as of soil; but in general, both are favorable to agriculture. "In the districts of the *Inn*, of *Lower Stiria*, of *Istria*, and of *Carniola*, the land is of good quality, well cultivated and very productive. In the last, they have two crops in the year; sowing buckwheat on wheat or rye stubble, and millet on

(1) In the *Dollart* what was lost by the sea was regained, and the marshes on the *Netz* and the *Warth* at *Friedberg*, and in *Pomerania*, were drained, and the country rendered habitable.

that of hemp and flax. They every where cultivate Indian corn, and in Stiria (as in Virginia) it forms the ordinary bread of the country." In Bohemia, Moravia, and Galitia, (1) the soil is uncommonly rich, and under proper management would be very productive. Austrian Silesia is less fitted for the production of grain, but excels in forage and cattle. Hungary, Transylvania, and Croatia, abound in every species of agricultural produce. Their flocks and pasturage are not inferior to those of the Ukraine; and wheat, buckwheat, Indian corn, millet, rice, hemp, flax and tobacco, yield immense harvests to very small degrees of labor. Yet is agriculture far from being in a flourishing condition! Writers on political economy ascribe this fact principally to two causes—

1st. The degradation and oppression of the laboring part of the community; and,

2d. The want of convenient commercial outlets for the produce of the soil.

We shall find in Hungary a striking illustration of the correctness of this opinion. "The *Populous Hungaricus*," is divided into four estates, the magnats, the nobles, and the clergy, who possess all the lands, and the "*misera contribuens plebs*," who (besides tythes, rents and corvees) pay all the taxes. This wretched populace is composed of the burghers and the peasantry, of which there are three kinds—*slaves for life*, *temporary slaves*, and a third sort called *libera emigrationis*, who, as their name in-

(1) Geographic Math.

dicates, have loco motive powers and rights. Of the condition of this people, since the year 1764, (and before that period it was much worse) we may form an idea from the edict of Maria Theresa, called the *urbarium*, or law of contracts between landlord and tenant, by which it is declared, that corporeal punishment inflicted by the master for insolent words or conduct,) shall not exceed twenty-four strokes with a cane for a man, and the same number with a switch for a woman. Nor is the *commercial* condition of this people better than the *civil*; they are not only obliged to take from Austria many things which they could have had in other places of a better quality and at a lower price, but they are also compelled to carry to Vienna the products of their own soil and labor, where their sale is embarrassed and their value lessened by heavy and oppressive taxes. The same remark applies to Galitia, whose natural outlet is the Vistula, or the Nieper; but of these she is not permitted to avail herself, and, like her sister kingdoms, is compelled to seek the markets furnished by the Danube and Trieste. "The consequences are obvious—the tenant works only to satisfy hunger, and the landlord is satisfied with little more than '*victum et vestitum.*'"(1)

The amount of lands annually cultivated in *Bavaria*, is one million one hundred and sixty-five thousand acres, which produce about six millions of bushels of grain, of which two millions are surplus. The Palatinate, (one of the dependencies of

(1) Geog. Math. vol. 4, article Hungary.

Bavaria,) is also very productive. The rout between Heidelberg and D'Armstadt, called the *Bergstrass*, traverses one of the finest districts of Germany, and perhaps of Europe; where are seen extensive vineyards, vast meadows and fertile fields, producing wheat, barley, tobacco, madder, rhubarb, turnips, &c. &c. In the year 1799, all the electoral possessions within the circle of Bavaria, contained 199,000 horses, 160,000 oxen, 465,000 cows, 961,000 sheep, 320,000 hogs, and 378,000 goats. Yet are the Bavarians, compared with the inhabitants of the north of Germany, half a century in the rear. The people are extremely ignorant and fanatical: like the people of Rome and Lisbon, they sacrifice much time to processions and fetes, and like them also are slaves of the vilest appetites. Debauchery is no where more flagrant than in Munich.(1)

Wurtemberg is ranked amongst the most fertile and well cultivated countries of Germany. The mountainous parts produce potatoes, oats, hemp and flax; the less hilly abound in wheat, spelts, rye, buckwheat, Indian corn and barley; and in the valleys we find tobacco, and madder, and vineyards, in which the grapes of France, Cyprus and Persia succeed perfectly. Apples, pears, &c. are of common product and of excellent quality.(2)

XI. It has been justly remarked, that to know the state of husbandry in any country, you have but to

(1) Geog. Math. &c. art. Bavaria. Compare the productiveness of Bavaria with England—the comparison is in favor of the former.

(2) Idem.

examine the *instruments* employed, the *succession* of *crops*, and the *condition* of *laborers*. Tried by these tests, the agriculture of *Russia* will be found to be in a state of great degradation. The plough (called *soka*) which is commonly used, is very light, of simple construction, and but calculated to enter the ground *one inch and a half*; the *harrow* consists of one or more young pine trees (whose branches are cut off about eight inches from the stem) steeped in water to add to their weight, and tied together. With such miserable instruments, each drawn by a single horse, the farmer scratches the ground, and without always covering the seed, which is no doubt the reason that in dry seasons their harvests are very bad. (1) In the best soil their *succession* of *crops* is of *eight years*—two in barley, two in oats, two in winter rye, and two in spring rye. Lands of less fertility are sown *two years* out of *three*, and mountainous tracts one year in three, when they are abandoned to weeds, until rest shall have reinstated them. “To manure them would, in the opinion of a Russian peasant, make them poorer;(2) and therefore he suffers his dung hill to accumulate into a nuisance, while he goes on to clear and exhaust new fields.” “The grains raised are rye, spelts, barley, millet and oats, which, from want of sufficient roads and markets, are often low priced; as are horned cattle and horses: an ox selling for a rouble and a half, a cow for one rouble, and a

(1) Pallas, pages 3 and 4, vol. i.

(2) Idem. vol. v. p. 60.

horse for three roubles.” (1) To this wretchedness we must add, (what perhaps occasions much of it,) that throughout the *civilized* part of Russia, the labors of agriculture are performed by *slaves* confounded with the soil, and bought and sold with it. In a great portion of the northern section of this vast empire, agriculture is unknown, and the chase, the fisheries, cattle and rein deer, furnish the only means of subsistence.

XII. The climate and soil of the united kingdoms of *Great Britain* and *Ireland*, are particularly favorable to husbandry; nor is her geographical position less auspicious—placed, as she is, on the longest line, and amidst the most important markets of the continent of Europe. If to these advantages be added the laborious, enlightened, and enterprising character of the nation, we cannot but expect results the most favorable to agriculture: yet is the fact notoriously otherwise. To show that this opinion is neither hasty nor unfounded, we must enter into details, which may not be unprofitable.

The surface of England is estimated at 37,265,853 acres, which are distributed as follows:

In pasturage,	-	-	-	-	18,796,458
In tillage,	-	-	-	-	11,350,501
In cities, roads and canals,	-	-	-	-	3,454,740
Lands fit for pasturage or tillage, not cultivated,	-	-	-	-	3,515,238
Lands unfit for cultivation,	-	-	-	-	2,148,921

Of the arable land the following annual disposition is made:

(1) A rouble is equal to 5 livres French, or 1 dollar Spanish,

In wheat and rye,	- - -	2,000,000
In peas, beans, and buckwheat,	- - -	2,000,000
In barley and oats,	- - -	4,000,000
In fallow, or in turnips or cabbages,	- - -	3,400,000

The lands in wheat and rye yield, on an average of ten years, *three quarters* per acre, or 6,000,000 quarters; yet is there an annual deficit in England of 1,820,000 quarters, which must be drawn from foreign markets.(1)

There is certainly nothing very flattering in this view of English agriculture; but it may be said to be one of statist and politicians, and probably underrated. Let us then see what their own most eminent agriculturists, their Young and St. Clair, and Dickson and Marshal, say on this subject—"A very small portion of the cultivated parts of Great Britain is, to this day, submitted to a judicious and well conducted system of husbandry; not in fact more than four counties (Norfolk, Sussex, Essex and Kent;) while many large tracts of excellent soil are managed in a way the most imperfect and disadvantageous."(2)

Nor is her management of cattle better. "Considering the domestic animals in a general way, we find each species, and almost every race, capable of great improvement, and with a few exceptions, the sheep much neglected. In some districts are whole races of cattle capable of improvement (within a rea-

(1) A *quarter* is equal to six bushels, and the average produce in wheat and rye 18 bushels per acre. For the whole kingdom the deficit is 2,820,000 quarters. See *Geographic Mathematique*, vol. art. Great Britain.

(2) See the introduction to Dickson's *Practical Agriculture*, 2d vol. *quarta*.

sonable time) in the three great objects which they are expected to yield, viz. milk, flesh and labor." (1) We now add *some* of the causes to which this defective husbandry has been ascribed: "to enumerate all would be impossible, from their number and complication." (2)

"1st. The *commons*, or unenclosed grounds, which in many places amount to near one half of the whole arable land, and which are submitted to the most absurd and ruinous system of culture." (3)

"2d. The *terms* (amounting to personal servitude) under which many of the lands are held."

"3d. The *shortness of leases* given by corporations, (civil and religious,) and by individuals, and which seldom exceed *three, five or seven* years, excepting in the counties of Norfolk, Sussex, Essex and Kent, where (with great advantage to both landlord and tenant) they are frequently extended to twenty-one years."

"4th. The *tithes in kind*, paid by the farmers to the church; a tax highly vexatious in its character and oppressive in its effects: and,

"5th. The *poor tax*, which has become enormous, and of which the yeomanry pay three fourths. Of this tax it has been truly said, that it is a powerful instrument of depopulation—a barbarous contrivance for checking all national industry." (4)

To these causes, assigned by British writers, may

(1) Marshal, vol. iv. p. 575.

(2) Dickson's Practical Agriculture.

(3) Idem.

(4) Young's Tour through Ireland, vol. ii. p. 302.

be added the *increase* of *population*, common to every nation of Europe, and which, in Great Britain, is beyond all proportion greater than the progress of agriculture, the *augmentation* of *cattle*, which occasions that of *pasturage*, and the diminution of *tillage*; (1) the *establishment* of *great farms* at the expence of *small* ones, and the *multiplication* of *parks* and *pleasure grounds*; and lastly, the *attractions* of *great cities*, and the *continual drafts* made upon the agricultural population, for the army and navy, and for commerce and manufactures.

SECTION III.

Theory of Vegetation.

VEGETABLES may be regarded as the intermediate link in the great chain of creation, between animals and minerals. The latter grow by mere chemical affinity, and by additions, sometimes analagous and sometimes foreign from their own nature; while plants, like animals, have an organization that enables them to receive their food, digest and assimilate

(1) Mr. Hume quotes with approbation an author, who complains of the decay of tillage in the reign of Elizabeth, and who ascribes it to the increase of pasturage, in consequence of the restraints imposed on the exportation of grain, while that of butter, cheese, &c. was free. The history of Europe, if read with an eye to public economy, furnishes abundant proof, that the greatest obstructions to agriculture have arisen from the interference of government. We have here no sly allusion to our own projects of a state board of agriculture, of a chemico-agricultural professorship, nor even of an agricultural college, if the treasury, in its wealth, and the legislature in its wisdom, should deem such institutions useful or necessary.

it to their own substance, reproduce their species and maintain an existence of longer or shorter duration. Thus far the learned are agreed, but at the next step they differ.

What is this food that gives to plants their development, and maturity, and powers of reproduction? Lord Bacon believed that *water* was the source of vegetable life, and that the earth was merely its home, its habitation, serving to keep plants upright and to guard them against the extremes of heat and cold. Tull, on the other hand, (and after him Du Hamel) pronounced *pulverized earth* the only pabulum of plants, and on this opinion built his system of husbandry. Van Helmont and Boyle opposed this doctrine by experiments: the former planted and reared a cutting of willow in a bed of dry earth carefully weighed and protected against accretion by a tin plate, so perforated as to admit only rain and distilled water, with which it was occasionally moistened. At the end of five years the plant was found to have increased *one hundred and sixty-four pounds*, and the bed of earth to have lost, of its original weight, only *two ounces*. Boyle pursued a similar process with gourds, and with a similar result. Notwithstanding the apparent conclusiveness of these experiments, their authority was shaken, if not subverted, by others made by Margraff, Bergman, Hales, Kirwan, &c. &c. The first of these shewed, that the rain water, employed by Van Helmont, was itself charged with saline and other earthy matter; Bergman demonstrated this by analysis, while Kirwan and Hales proved that the earth, in which

the willow cutting was planted, could absorb these matters through the pores of the wooden box which contained it, and that a glass case could alone have prevented such absorption. Hunter, finding that oil and salt entered into the composition of plants, concluded that these formed their principal food, and accordingly recommended, as the great desideratum in agriculture, an *oil compost*. Lord Kaim's attempted to revive the expiring creed of Lord Bacon, but finding from Hales' statics, that one third of the weight of a green pea was made up of carbonic acid, he added *air* to the watery aliment of the English philosopher—but entirely rejected *oil* and *earth*, as too gross to enter the mouths of plants, and *salt*, as too acrid to afford them nourishment. Quackery, which at one time or other, has made its way into all arts and sciences, could not easily be excluded from agriculture. Hence it was that the Abbe de Valemont's *prolific liquor*, and De Hare's and De Vallier's *powders*, &c. &c. were believed to be all that was necessary to vegetation, and found the more advocates, as they promised much and cost little. But before the march of modern chemistry, quackery could not long maintain itself; and from the labors of Bennet, Priestly, Saussure, Ingenhouz, Sennebier, Schæder, Chaptel, and Davy, &c. &c. few doubts remain on this important subject. These will be presented in the course of the following inquiry.

I. Of *earths*, and their relation to vegetation.

Of six or eight substances, which chemists have denominated *earths*, four are widely and abundant-

ly diffused, and form the crust of our globe. These are *silica*, *alumina*, *lime*, and *magnesia*. The first is the basis of quartz, sand and gravel; the second of clay; the third, of bones, river and marine shells, alabaster, marble, limestone and chalk; and the fourth, of that medicinal article known by the name of calcined magnesia. In a pure or insulated state, (1) these earths are wholly unproductive; but when decomposed and mixed, (2) and to this mixture is added the residuum of dead animal or vegetable matter, (3) they become fertile, take the general name of *soils*, and are again specially denominated after the earth that most abounds in their compositions respectively. If this be silica, they are called *sandy*; if alumina, *argillaceous*; if lime, *calcareous*; and if magnesia, *magnesian*. Their properties are well known: a *sandy* soil is loose, easily moved, little retentive of moisture, and subject to extreme dryness; an *argillaceous* soil is hard and compact when dry, tough and paste like when wet, greedy and te-

(1) See Gisbert's experiments on *pure earths* and *their mixtures*. See also Davy's *Elements*, p. 156.

(2) In this respect nature has been neither negligent nor niggardly, if (as Fourcroy asserts) the purest sand be a mixture of quartz, alumina, and sometimes of calcareous matter. *Speculative geology* is romance, and does not merit the name of science; yet is science obliged to borrow her theory of soils. The alternation of heat and cold, moisture and dryness, *decomposed* the mountains of primitive, secondary and tertiary formation; rains and the laws of gravity, brought these broken parts from places of more, to those of less elevation—where, by mechanical mixture and chemical combination, the present substrata were formed. But these were yet naked and unproductive, when the Cryptogamia family (mosses and lichens) took possession of them, and in *due time* produced that vegetable matter, which made the earth productive and the globe habitable!

(3) Dead animal and vegetable matter, in the last stage of decomposition, give a black or brown powder, which the French chemists call *terreau*, or *humus*, and which Mr. Davy calls an *extractive matter*; this is the fertilizing principle of soils and manures.

tenacious of moisture ; turns up, when ploughed, into massive clods, and admits the entrance of roots with great difficulty. A *calcareous* soil is dry, friable and porous ; water enters and leaves it with facility ; roots penetrate it without difficulty, and [being already greatly divided] less labor is necessary for it than for clay. *Magnesian*, like calcareous earth, is light, porous and friable, but like clay, when wet, takes the consistency of paste, and is very tenacious of water. It refuses to combine with oxygen or with the alkalies : is generally found associated with granit, gneiss, and schiste, and is probably among the causes of their comparative barrenness.(1)

In these qualities are found the *mechanical relations* between earths and vegetables. To the divisibility of the former it is owing, that the latter are enabled to push their roots into the earth ; to their *density*, that plants maintain themselves in an erect posture, rise into the air and resist the action of winds and rains ; and to their *power* of *absorbing* and *holding* water, the advantage of a prolonged application of moisture, necessary or useful to vegetable life. But besides performing these important offices, there is reason to believe that they contribute to the *food* of vegetables. This opinion rests on the following considerations and experiments :

1. If earths do not contribute directly to the food

(1) The opinion is general among the chemists of Europe, that magnesian earth is not only barren itself, but the cause of barrenness in other soils in which it may abound, unless saturated with carbonic acid. See Bosc, Tenant and Davy.

of plants, then would be all soils alike productive ; or in other words, if air and water *exclusively* supply this food, then would a soil of pure sand be as productive as one of the richest alluvion.

2. Though plants may be made to grow in pounded glass, or in metallic oxides, yet is the growth, in these, neither healthy nor vigorous : and,

3. All plants, on analysis, yield an earthy product ;(1) and this product is found to partake of the earth that predominates in the soil producing the analyzed plant. This important fact is proved by De Saussure.

FIRST EXPERIMENT.

Two plants (the *pinus abies*) were selected, the one from a calcarious, the other from a granitic soil, the ashes of which gave the following products :

	<i>Granitic soil.</i>	<i>Calcarious soil.</i>
Potash	3 60	15
Alk. and mu. sulphates	4 24	15
Carbonate of lime	46 34	63
Carbonate of magnesia	6 77	00
Silica	13 49	00
Alumina	14 86	16
Metallic oxides	10 52	00

SECOND EXPERIMENT.

Two *Rhododendrons* were taken, one from the calcarious soil of Mount de la Salle, the other from the granitic soil of Mount Bevern. Of a *hundred* parts, the former gave fifty-seven of carbonate of

(1) Davy says this never exceeds one fiftieth of the whole product.

lime and five of silica; the latter thirty of carbonate of lime and fourteen of silica.

THIRD EXPERIMENT.

This was made to determine whether vegetables, the product of a soil having in it no silica, would, notwithstanding, partake of that earth. Plants were accordingly taken from Reculey de Thoiry, (a soil altogether calcarious,) and the result was a very small portion of silica.

These experiments, says Chaptal, leave little if any doubt, but that vegetables derive the earthy matter they contain from the soil in which they grow.(1)

II. Of *water*, as an agent in vegetation.

Seeds placed in the earth, and in a temperature above the freezing point, and *watered*, will develop; that is, their lobes(2) will swell, their roots descend into the earth, and their stems rise into the air. But without humidity, they will not germinate; or deprived of humidity after germination, they will perish. When germination is complete and the plant formed, its roots and leaves are so organized as to *absorb water*. The experiments of Hales prove, that the weight of plants is increased in wet and diminished in dry weather; and that in the latter, they draw from the atmosphere, (by

(1) Schæder maintains the doctrine, that the earths found in plants are created there by the process of vegetation. His essay on this subject was crowned by the academy of Berlin, in 1801. His experiments were the first to determine the different quantities of silica found in different kinds of grain.

(2) Moisten a bean in warm water, and detach the skin that covers it, and it readily divides into two parts; these are called *lobes*.

means of their leaves,)(1) the moisture necessary for their well being. Du Hainel (and after him Sennebier) has shown, that the filaments that surround the roots of plants, and which have been called their hair, perform for them in the *earth* the office that leaves perform in the atmosphere, and that if deprived of these filaments the plants die.

It would be easy, but useless, to multiply facts of this kind, tending to establish a doctrine not contested, but which after all does not assert, that water makes any part of the food of plants. On this point two opinions exist—the one, that this liquid is a solvent and conductor of alimentary juices; the other, that it is itself an aliment and purveyor of vegetable food at the same time. The first opinion is abundantly established. Water, when charged with oxygen, supplies to germinating seeds the want of atmospheric air, and saturated with animal or vegetable matter in a state of decomposition, or slightly impregnated with carbonic acid, very perceptibly quickens and invigorates vegetation. The second opinion is favored by some of De Saussure's experiments. On these, Chaptal makes the following remark, which expresses very distinctly an approbation of the doctrine they suggest: “The enormous quantity of hydrogen (which makes so large a part of vegetable matter) cannot be accounted for, but by admitting (in the process of vegetation) the *decomposition* of *water*, of which

(1) Bonnet's experiments shew, that it is the under surface of the leaf that performs this function. The upper surface has a different office.

dryhydrogen is the principal constituent; and that though there is nothing in the present state of our experience that directly establishes this doctrine, yet that its truth ought to be presumed, from the analysis of plants and the necessary and well known action of water on vegetation.”

III. Of *air*, and its agency in vegetation :

A seed deprived of air will not germinate ; and a plant placed under an exhausted receiver, will soon perish. Even in a close and badly ventilated garden, vegetables indicate their situation ; they are sickly in appearance, and vapid in taste. These facts sufficiently shew the general utility of air to vegetation : but this *air* is not now the simple and elementary body, that the ancient chemists described it to be. Priestly first, (1) and Lavoisier after him, analysed it, and found, that when pure, it consisted of about 70 parts of azote, 27 of oxygen, and 2 of carbonic acid. In its ordinary (or impure) state, it is loaded with foreign and light bodies ; such as mineral, animal and vegetable vapors, the seeds of plants and the eggs of insects, &c. Is it to this *aggregate*, that vegetation owes the services rendered to it by air ? And if not, to *how many*, and to *which*, of its regular constituents, are we to ascribe them ? This enquiry will form the subject of the present article.

All vegetables in a state of decomposition, give *azote* ; and some of them [cabbages, radishes, &c.] give it in great quantity. This abundance, combin-

(1) See Priestly's Experiments and Observations on different kinds of Air, begun in 1767.

ed with the fact, that vegetation is always vigorous in the neighborhood of dead animal matter, led to the opinion, that azote contributed largely to the growth of plants; but experiments, more exactly made and often repeated, disprove this opinion, and shew that in any quantity it is unnecessary, and that in a certain proportion it is fatal to vegetation.

In *hydrogen gas*, plants are found to be variously affected, according to their local situation; if inhabitants of mountains, they soon perish—if of plains, they shew a constant debility—but if of marshy grounds, their growth is not impeded.

Carbonic acid is formed and given out during the process of fermentation, putrefaction, respiration, &c. and makes 28 parts out of 100 of atmospheric air. It is composed (according to Davy) of oxygen and carbon, in the proportion of 34 of the former to 13 of the latter. It combines freely with many different bodies; animals and vegetables are almost entirely composed of it; for the *coal* which they give, on combustion, is but *carbon* united to a little oxygen, &c. Priestly was the first to discover that plants *absorbed carbonic acid*; and Ingenhouse, Sennebier and De Saussure have proved, that it is their *principal aliment*. Indeed the great consumption made of it, cannot be explained by any natural process, excepting that of vegetation. On this head we cannot do better than digest the experiments of the last of these chemists into a few distinct proportions: (1)

(1) Recherches chimiques sur la vegetation, chap. ii.

1. In pure carbonic acid gas, seeds will swell, but not germinate. 2. United with water, this gas hastens vegetation. 3. Air containing more than one twelfth part of its volume of carbonic acid, is most favorable to vegetation. 4. Turf, or other carbonaceous earth, which contains much carbonic acid, is unfavorable to vegetation until it has been exposed to the action of atmospheric air, or of lime, &c. 5. If slacked lime be applied to a plant, its growth will be impaired until the lime shall have recovered the carbonic acid it lost by calcination. 6. Plants kept in an artificial atmosphere and charged with carbonic acid, yield, on combustion, more of that acid than plants of the same kind and weight growing in atmospheric air. 7. When plants are exposed to air and sunshine, the carbonic acid of the atmosphere is consumed, and a portion of oxygen left in its place. If new supplies of carbonic acid be given to the air, the same result follows; whence it has been concluded, that air furnishes carbonic acid to the plant, and the plant furnishes oxygen to the air. This double function of absorption and respiration, is performed by the green leaves of plants.(1) 8. Carbon is to vegetation what oxygen is to animal life; it gives support by purifying the liquids and rendering the solids more compact.

IV. Of *light, heat and electricity*, and their agency in vegetation:

When deprived of light, plants are pale, lax and dropsical; restored to it, they recover their colour,

(1) This was a discovery of Sennebier.

consistency and odour. If a plant be placed in a cellar, into which is admitted a small portion of light through a window or cranny, thither the plant directs its growth, and even acquires an unnatural length in its attempt to reach it.(1) These facts admitted, no one can doubt the agency of light in vegetation; but in relation to this agency, various opinions exist; one, that light enters vegetable matter and combines with it; another, that it makes no part either of the vegetable or of its aliment, but directly influences substances which are alimentary;(2) and a third, that besides the last effect, it stimulates the organs of plants to the exercise of their natural functions.(3)

Without doing more than state these opinions, we proceed to offer the results of many experiments on this subject. 1st. That *in the dark*, no oxygen is produced, nor any carbonic acid absorbed; on the contrary, oxygen is absorbed and carbonic acid produced. 2d. That plants exposed to *light*, produce oxygen gas in water. 3d. That *light* is essential to vegetable transpiration; as this process never takes place during the *night*, but is copious during the *day*; and 4th. That plants raised *in the dark* abound in watery and saccharine juices—but are deficient in woody fibre, oil and resins; whence it is concluded, that saccharine compounds are formed in the *night*, and oil, resins, &c. in the *day*.

(1) It is by a knowledge of this fact, that gardeners bleach chicory and celeriac, &c.

(2) See Fourcroy, vol. viii.

(3) See Chaptal on vegetation.

When the weather is at or below the freezing point, the sap of plants remains suspended and hardened in the albumum;(1) but on the application of *heat*, whether naturally or artificially excited, this sap is rendered fluid, is put into motion and the buds begin to swell. Under the same impulse, through the medium of the earth, the roots open their pores, receive nutritive juices, and carry them to the heart of the plant. The leaves being now developed, begin and continue the exercise of their functions, till winter again, in the economy of nature, suspends the operations of the machine. Nor is its action confined to the circulation of vegetable juices; without vapor (its legitimate offspring) the fountain and the shower would be unknown—nor would the great processes of animal and vegetable fermentation and decomposition go on. Without rain or other means of ameliorating the soil, what would be the aspect of the globe? what the state of vegetation? what the situation of man?

The diffusion of *electrical* matter, found in the air and in all other substances, furnishes a presumption, that it is an efficient agent in vegetation. Nollet and others have thought that, artificially employed, it favored the germination of seeds and the growth of plants; and Mr. Davy “found, that corn sprouted more rapidly in water, *positively* electrified by the voltaic battery, than in water *negatively* electrified.” (2) These opinions have not escaped

(1) Knight's Observations, &c.

(2) Davy's Elements.

contradiction, and *we* do not profess to decide where doctors disagree.

V. Of *stable yard manures, lime, marl and gypsum*, and their agency in vegetation.

We have already said, that vegetables in the last stage of decomposition, yield a black or brown powder, which Mr. Davy calls "*a peculiar extractive matter, of fertilizing quality,*" and which the chemists of France have denominated *terreau*. This vegetable residuum is the simple mean employed by nature to re-establish that principle of fertility in the soil, which the wants of man and other animals are constantly drawing from it. It was first analysed by Hessenfratz, who found it to contain an oily, extractive and carbonaceous matter, charged with hydrogen; the acetates and benzoates of potash, lime and ammoniac; the sulphates and muriates of potash, and a soapy substance, previously noticed by Bergman. Among other properties (and which shows its combustible character) is that of absorbing, from atmospheric air, its oxygen, and leaving it only azote. This was discovered by Ingenhouse, who, with De Saussure and Braconnet, pursued the subject by many new and interesting experiments, the result of which is—

1. That the oxygen thus absorbed, deprives the *terreau* of part of its carbon, which it renders soluble and converts into mucilage; and,

2. That the carbonic acid, formed in the process, combines with the mucilage, and with it is absorbed by the roots of plants.

If we put a plant and a quantity of slacked

lime under the same receiver, the plant will perish; because the lime will take from the atmospheric air all the carbonic acid it contains, and thus *starve* the plant. Vegetables, placed near heaps of lime in the open air, suffer from the same cause and in the same way; but though lime, in *large* quantities, destroys vegetation, in *small* quantities it renders vegetation more vigorous. Its action is of two kinds—mechanical and chemical; the first is a mere division of the soil by an interposition between its parts; the second, the faculty of rendering soluble vegetable matter, and reducing it to the condition of terreau.

The *mechanical* agency ascribed to lime, belongs also to *marle* and to *ashes*, and in an equal degree—but their *chemical* operation, though similar, is less. (1)

Gypsum is composed of lime and sulphuric acid. Mayer was the first to present to the public a series of experiments upon it, in its relation to agriculture. Many chemists have followed him, and a great variety of opinion yet exists with regard to its mode of operation. Yvart thinks, that the action of gypsum is exclusively the effect of the sulphuric acid, which enters into its composition; and founds this opinion upon the fact, that the ashes of turf, which contain sulphate of iron, and sulphate of alumina, have the same action upon vegetation as gypsum. Laysterie, observing that plants, whose roots were nearest the surface of the soil, were most acted upon by plaster,

(1) Vegetable ashes are *lime*, combined with an earthy saline matter.

concludes, that gypsum takes from the atmosphere the elements of vegetable life and transmits them directly to plants. Bosc intimates, that the *septic* quality of gypsum (which he takes for granted) best explains its action on vegetation; but this opinion is subverted by the experiments of Mr. Davy—who found, that of two parcels of minced veal, the one mixed with gypsum, the other left by itself, and both exposed to the action of the sun, the *latter* was the first to exhibit symptoms of putrefaction. Mr. Davy's own belief on this subject is, that it makes part of the food of vegetables, is received into the plant and combined with it. The last opinion we shall offer on this head, is that of the celebrated Chaptal. "Of all substances, gypsum is that of whose action we know the least. The prodigious effect it has on the whole race of trefoils (clover, &c.) cannot be explained by any *mechanical* agency—the quantity applied being so small—nor by any *stimulating* power—since gypsum, raw or roasted, has nearly the same effect; nor by any *absorbent* quality, as it only acts when applied to the leaves. If permitted to conjecture its mode of operation, we should say, that its effects being greatest when applied to the *wet* leaves of vegetables, it may have the faculty of absorbing and giving out water and carbonic acid, little by little, to the growing plant. It may also be considered as an *aliment in itself*—an idea much supported by Mr. Davy's experiments, which shew, that the ashes of clover yield gypsum, though the clover be raised on soils not naturally containing that substance."

SECTION IV.

Of the Analysis of Soils, and of the Agricultural Relations between Soils and Plants.

We have seen that the earths have a threefold capacity; that they receive and lodge the roots of plants and support their stems; that they absorb and hold air, water and mucilage—aliments necessary to vegetable life: and that they even yield a portion of themselves to these aliments. But we have also seen, that they are not equally adapted to these offices; that their parts, texture and qualities are different; that they are cold or warm, wet or dry, porous or compact, barren or productive, in proportion as one or other may predominate in the soil: and that to fit them for discharging the various functions to which they are destined, each must contribute its share, and all be minutely divided and intimately mixed. In this great work nature has performed her part; but as is usual with her, she has wisely and benevolently left something for man to do.

This necessary march of human industry, obviously begins by ascertaining the *nature of the soil*. But neither the touch, nor the eye, however practised or acute, can in all cases determine this. *Clay*, when wet, is cold and tenacious—a description that belongs also to magnesian earths: *sand* and *gravel* are hard and granular; but so also are

some of the modifications of lime : *vegetable mould* is black and friable, but not exclusively so : for schistous and carbonaceous earths have the same properties.

It is here, then, that chemistry offers herself to obviate difficulties, and remove doubts ; but neither the apparatus nor process of this science, are within the reach of all who are interested in the enquiry, and we accordingly subjoin a method, less comprehensive, but more simple and sufficiently exact, for agricultural purposes, and which calls only for two vases, a pair of scales, clean water and a little sulphuric acid.

“ 1st. Take a small quantity of earth from different parts of the field, the soil of which you wish to ascertain, mix them well together and weigh them ; put them in an oven, heated for baking bread, and after they are dried, weigh them again ; the difference will show the *absorbent power of the earth*. When the loss of weight in 400 grains, amounts to 50, this power is great, and indicates the presence of much animal or vegetable matter ; but when it does not exceed twenty, the absorbent power is small, and the vegetable matter deficient.(1)

2d. Put the dried mass into a vase with one fourth of its own weight of clear water ; mix them well together ; pour off the dirty water into a second vase, and pour on as much clean water as before ; stir the contents, and continue this process until the water poured off is as clear as that poured on the

(1) See Davy's elements.

earth. What remains in the first employed vase, is *sand, silicious or calcarious*.

3d. The dirty water, collected in the second vase, will form a deposit, which (after pouring off the water) must be dried, weighed and *calcined*. On weighing it *after* this process, the quantity lost will shew the portion of *animal and vegetable mould contained in the soil*: and,

4th. This calcined matter must then be carefully pulverised and weighed, as also the first deposit of sand, but without mixing them. To these, apply (separately) sulphuric acid, and what they respectively lose in weight, is the portion of *calcarious or aluminous earths* contained in them. These last may be separated from the mass by soap lye, which dissolves them.”(1)

Here is the light we wanted. In knowing the disease, we find the cure. Clay and sand qualify each other; either of these will correct an excess of lime; and magnesian earth, when saturated with *carbonic acid*, becomes fertile.

But entirely to alter the constitution of a soil, whether by mechanical or other means, is a work of time, labor and expense, and little adapted to the pecuniary circumstances of farmers in general.—Fortunately, a remedy, cheaper, more accessible and less difficult, is found in that *great diversity* of habits and character, which mark the vegetable races. We shall, therefore, in what remains of this

(1) This method of analyzing soils, is that described by M. Bosc, member of the institute of France, &c. and recommended to French agriculturists

section, indicate the principal of these, as furnishing the basis of all rational agriculture.

1st. *Plants have different systems of roots, stems and leaves, and adapt themselves accordingly to different kinds of soils* : the *Tussilago* prefers clay, the *Spergula* sand ; *Asparagus* will not flourish on a bed of granit, nor *Muscus Islandicus* on one of alluvion.— It is obvious, that *fibrous rooted* plants, which occupy only the surface of the earth, can subsist on comparatively stiff and compact soils, in which those of the leguminous and cruciform families would perish, from inability to penetrate and divide.

2d. *Plants of the same or of a similar kind, do not follow each other advantageously in the same soil.* Every careful observer must have seen how grasses alternate in meadows or pastures, where nature is left to herself. At one time timothy, at another clover, at a third red-top, and at a fourth blue grass prevails. The same remark applies to forest trees ; the original growth of wood is rarely succeeded by a second of the same kind ; pine is followed by oak, oak by chesnut, chesnut by hickory. A young apple tree will not live in the place where an old one has died ; even the pear tree does not thrive in succession to an apple tree, but stone fruit will follow either with advantage. “In the Gautinois, (says Bosc,) saffron is not resumed but after a lapse of twenty years ; and in the Netherlands, flax and colzat require an interval of six years. Peas, when they follow beans, give a lighter crop than when they succeed plants of another family.”(1)

(1) The ill effect of a succession of crops of the same kind was not unknown to the

3d. *Vegetables, whether of the same family or not, having a similar structure of roots, should not succeed each other.* It has been observed that trees suffer considerably by the neighborhood of sainfoin and lucern, on account of the great depth to which the roots of these plants penetrate—whereas culmiferous grasses do them no harm.

4th. *Annual or biennial trefoils prevent the escape of moisture from sandy and arid soils, and should constantly cover them in the absence of other plants;*(1) *while drying and dividing crops, as beans, cabbages, chickory, &c. &c. are best fitted to correct the faults of stiff and wet clays.*

5th. *When plants are cultivated in rows or hills, and the ground between them is thoroughly worked, the earth is kept open, divided and permeable to air, heat and water, and accordingly receives from the atmosphere nearly as much alimentary provision as it gives to the plant.* This principle is the basis of the drill husbandry.

6th. *All plants permitted to go through the phases of vegetation (and of course to give their seeds) exhaust the ground, in a greater or less degree ; but if cut green, and before seeding, they take little from the principle of fertility.*

7th. *Plants are exhausters in proportion to the length of time they occupy the soil.* Those of the culmiferous kinds (wheat, rye, &c.) do not ripen un-

Romans. We have proof of this in the following passage of Festus : “ Restibilis ager fit qui continuo biennio seritur farreo spico, id est aristato, quod, ne fiat solent, qui pradia locant, excipere.”

(1) The “ Sterilis tellus medio versatur in æstu,” of Virgil, shows the opinion he entertained of a husbandry that left the fields without vegetation.

der ten months, and during this period, forbid the earth from being stirred; while, on the other hand, leguminous plants occupy it but six months, and permit frequent ploughings. This is one reason why culmiferous crops are greater exhausters than leguminous: another is, that the stems of culmiferous plants become hard and flinty, and their leaves dry and yellow, from the time of flowering till the ripening of the seed—loosing their inhaling or absorbing faculties—circulating no juices, and living altogether in their roots, and on aliments exclusively derived from the earth—whereas leguminous or cruciferous plants, as cabbages, turnips, &c. &c. have succulent stems, and broad and porous leaves, and draw their principal nourishment from the atmosphere. The remains of culmiferous crops also are fewer, and less easily decomposed, than those of the leguminous family.

8th. *Meadows, natural and artificial, yield the food necessary to cattle, and, in proportion as these are multiplied, manures are increased and the soil made better.* Another circumstance that recommends them is, that so long as they last, they exact but little labor, and leave the whole force of the farmer to be directed to his arable grounds.

9th. *Grasses are either fibrous or tap-rooted, or both. The remarks already made, in articles 1, 2 & 3, apply also to them.* Timothy, red top, oat grass, and rye grass, succeed best in stiff, wet soils. Sainfoin does well on soils the most bare, mountainous and arid; lucern and the trefoils, (or clovers,)

only attain the perfection of which they are susceptible, in warm, dry, calcarious earth.

10th. *The ameliorating quality of tap-rooted plants is supposed to be in proportion to their natural duration*; annual clover, (lupinella,) has less of this property than biennial, (Dutch clover,) biennial less than sainfoin, and sainfoin less than lucern.

11th. *Any green crop ploughed into the soil, has an effect highly improving*; but for this purpose, lupins and buckwheat (cut when in flower) are most proper.

12th. *Mixed crops, (as Indian corn, pumpkins, and peas and oats,) are much and profitably employed, and with less injury to the soil than either corn or oats alone.*(1)

(1) The good effect of these mixtures was known to the ancients, from whom the practice has descended to us. What a picture of fertility and abundance have we in the 22d chap. 18th book of Pliny's Natural History: "Sub vite seritur frumentum, mox legumen, decinde olus, omnia, eodem anno, omniaque aliena umbra aluntur."

SECTION V.

Of Practical Agriculture and its necessary Instruments.

WE begin this part of our subject with a few remarks on the instruments necessary to agriculture, which may be comprised under the well known names of the plough, the harrow, the roller, the threshing machine and the fanning mill.

1st. Of the plough.

It is among the inscrutable dispensations of Providence, that the arts most useful to man, have been of later discovery—of slower growth, and of less marked improvement, than those that aimed only at his destruction. At a time when the phalanx and the legion were invented and perfected, and when the instruments they employed were various and powerful, those of agriculture continued to be few and simple, and inefficient.

Of the Greek plough, we know nothing ; and the general disuse of that described by Virgil and Pliny, furnishes a degree of evidence, that experience has found it incompetent to its objects. With even the boasted lights of modern knowledge, scientific men are not agreed upon the form and proportions most proper for this instrument. As in other cases, so in this, there may be no *abstract perfection* ; what is best in one description of soil, may not be so in another ; yet, as in all soils, the office of the plough is the same, viz. to *cleave and turn over the earth*, there cannot but be some definite shape and proportions, better fitted for these purposes, and at the same time less susceptible of resistance, than any other.

This beau ideal, this suppositious excellence, in the mechanism of a plough, has been the object of great national, as well as individual research. In Great Britain, high prizes have been established for its attainment ; and in France, under the ministry of Chaptal, 10,000 francs, or \$2000, were offered for this object, by the agricultural society of the Seine. In both countries, the subject has employed many

able pens ; those of Lord Kaims, of Mr. Young, of Mr. Arbuthnot, of Lord Somerville, and of Messieurs Duhamel, Chateauvieux, Bosc, Guillaume, &c. It is not for us, therefore, to do more than assemble and present such rules for the construction of this instrument, as have most attained the authority of maxims.

1st. The beam, or that part of the plough which carries the coulter, and furnishes the point of draft, should be as near that of resistance as possible ; because the more these are approached, the less is the moving power required. Even the shape of the beam is not a matter of indifference. In the old ploughs it was generally straight, but a small curve is now preferred ; because it has the effect of strengthening the coulter, by shortening it.

2d. The *head* of the plough is the plane on which it moves. This should be concave, because that form offers fewer points of friction, and, of course, less resistance. Between the beam and the head, is an angle, on which depends the principal office of the plough ; the making, at will, a deep or a shallow furrow. If you wish a deep furrow, diminish the angle, and vice versa : but this angle should, in no case, exceed from 18 to 24 degrees.

The resistance made to the plough being produced less by the weight of the earth, than by the cohesion of its parts, it is evident that the head should be shod with iron, and rendered as smooth as possible. This remark applies equally to the soc and to the mouldboard.

3d. The *soc*, in its widest part, should be larger than the head. It has different shapes in different countries. In some is given to it that of an isosceles triangle; in others, that of the head of a lance: in Biscay, that of a crescent; and in Poland, of a two pronged fork. But, whatever be its shape, it should be well pointed and polished—enter the earth with facility, and cut it easily.

4th. To the *mouldboard*, some workmen give the shape of a prismatic wedge; others make the upper part convex, and the lower concave; while many make it entirely flat. In stiff soils, the *semi cycloid* is the form to be preferred, and in loose friable soils the *semi ellipsis*.⁽¹⁾ The iron mouldboards have great advantages over the wooden, particularly when they, the shear and the soc, form one piece, as in the ploughs of Mr. Cook.

It is a general opinion, that a heavy plough is more disadvantageous than a light one; because the draft of the former, being greater, will be more fatiguing to the cattle; but the experiments of the agricultural society in London, establish a contrary doctrine, and show, that in light grounds, the labor is more easily and better performed, with a heavy, than with a light plough.

5th. The *coller* is a species of knife inserted in the beam, and so placed before the soc, as to cut the sod. It is susceptible of being raised or depressed at will.

6th. The handles of the plough ought to be made

(1) See Arbuthnot on ploughs.

of some kind of heavy wood, that they may operate as a counter-weight to the head, the soc and the mouldboard.

To these remarks we subjoin two sets of experiments, made with the most approved French and English ploughs—that of Guillaume and Small's *Rotheram plough improved*, which furnish a means of comparison between the best ploughs of Europe and those of this country.

The resistance (stated in these tables) was measured and ascertained by a *dynonometer*, a machine indispensable to those who would make correct observations on the relative advantages of different ploughs.

THE FRENCH PLOUGH.		THE ENGLISH PLOUGH.	
<i>Resistance in pounds.</i>		<i>Resistance in pounds.</i>	
1st experiment,	200	1st experiment,	360
2d do.	240	2d do.	380
3d do.	200	3d do.	480
4th do.	220	4th do.	460
5th do.	220	5th do.	400
	—	6th do.	400
Divided by 5 J	1080	7th do.	420
	—	8th do.	386
Average,	216	9th do.	410
			—
		Divided by 9 J	3720
			—
		Average,	413

II. *The Harrow.* This is of different kinds—the triangular and the square, the single and the dou-

ble. But of whatever form, its uses are the same ; to smooth the field after ploughing, to break and pulverize the clods, and to cover the seed. These uses sufficiently indicate the propriety of employing two, in succession ; one of heavy frame, with few and long teeth, like the Scotch brake ; the other, of lighter construction, with more and shorter teeth. Our own experience leads us to believe, that the common harrow covers the seed too much, because small seeds will not vegetate at a depth greater than three inches.

III. *The Roller* is a cylinder of heavy wood, turning on gudgeons, or on an axle, and placed in a frame, to which is attached a shaft ; it is of different dimensions, but need not exceed that which may be drawn by one, or at most by two horses or oxen. This instrument is indispensable in good husbandry, yet it is rarely used in ours. Its offices are three-fold—to render loose soils more compact ; to break the clods on stiff ones, and on both, to compress the earth (after seeding) so that it be every where brought in contact with the grain. It is also usefully employed in reinstating the roots of meadow grasses, loosened and raised by the alternate freezing and thawing of the ground, and, with a similar view, may be passed over winter crops early in the spring.

Its clod breaking and pulverizing property, is much increased, by surrounding the roller with narrow bands of iron, two inches broad, three inches thick and six inches assunder ; or by studding it

with iron points, resembling harrow teeth, and projecting three or four inches.

IV. *The Threshing Machine* is of English invention, and may be well enough adapted to the taste and circumstances of rich amateurs, but not at all to those of farmers in general. Our objections to it are three—the first cost, which is great; the quantum of moving power employed, which is equal to that of six horses, and the number of hands required to attend it, which is not less than four. We have seen, in France, a machine for the same purpose, but of much simpler structure—called the “*Rouleau de depiquer*,” which is only a *fluted cylinder*; yet simple and cheap as this was, it could not maintain itself against the more ancient instruments—the flail and the horse. Still it is to be hoped, that new experiments may succeed better and abridge the manual labor usually given to this branch of husbandry, and, that the mechanical genius of our own country (which is not inferior to that of any other) may be the first to combine *power* and *cheapness* in this machine.

This hope is probably suggested, by the description of a new invented threshing machine, now before me, and which I may be permitted to transcribe from the letter of the inventor. “The machine I have built is three feet wide. One horse will thresh, with much ease, as much wheat as can be laid on it by one man, (the straw to be taken away by another,) say, from *fifty to one hundred bushels in a day*, and the saving of grain will pay for the labor; for, I think, that with good attendance, not a particle of

grain can escape with the straw. The expense of the machine will be from *fifty to seventy dollars*, exclusive of the moving power, which is a wheel, about ten feet diameter, on an upright shaft, to which a lever is fixed to hitch the horse. Into this main wheel, a small one should be made to work, about two feet diameter, on a shaft carrying a drum four feet wide. With this simple gearing, and drawn by a horse that walks well, the machine will give about eighteen hundred strokes in a minute, and if fully attended, will, without hard labor for the horse, thresh *a bushel every three or four minutes*. It stands in my barn, and may be seen and examined by any one.”(1)

V. *The Fanning Mill*: Other things being equal, the cleanest wheat is most easily preserved, and, on manufacture, gives the best flour and in the largest quantity. These considerations offer inducement enough for the employment of this machine, which, besides doing its business well, saves a great deal of time. It is too well known to require description.

(1) Mr. L. McKeen, Poughkeepsie.

SECTION VI.

Of Manures---their management and application.

THE principle of fertility, (the result of animal and vegetable decomposition,) is, as we have seen,

susceptible of solution, and in this form becomes the aliment of that artificial vegetation, which is the work of man, and which leaves so little on the earth, to compensate for the great deal it takes from it. In a course of years, therefore, there will be an actual loss or subtraction of matter, useful or necessary to the growth of plants, which can only be re-established by manures of vegetable or animal origin. The most approved methods of preserving and applying these, must therefore be among the objects most important to the agriculturist; and that the reader may better understand the reasons of the practice we mean to recommend, we begin the discussion with Kierwan's analysis of stable manures.(1)

		Charcoal.	Lime.	Clay.	Sand.	Fixed Salts.	Carburated hyd. carb. acid and water
105 lbs of {	Cow dung,	3.75	1.20	0.15	2 4	0. 6	92.80
	Horse dung,	10. 2	1.50	0.50	3. 0	0.21	89.77
	Sheep dung, }	25. 0	10.28	29. 0	29. 0	0.72	68.00

The elementary parts of these manures, as exhibited in this table, sufficiently indicate the mode of *preserving them*. When dropped in the fields and in small parcels, by cattle, they exhibit no signs of fermentation, nor undergo, in that state, any degree of chemical decomposition; but when brought to-

(1) Tull and Du Hamel's doctrine, that frequent ploughings and sowings superseded the necessity of manure, is no longer held by any well instructed agriculturist. The maxim of Oliver de Serris is much better founded. "Le bien labourer, le bien fumer, est tout le secret de l'agriculture." Till well and manure well, is the whole secret of agriculture.

gether and frequently wetted and subjected to the action of atmospheric air, they are speedily dissolved and give out much gaseous matter. To prevent the escape of these soluble and volatile parts, two things are necessary: 1st, that the dung be collected in a reservoir, of convenient size, walled and paved with stones; and 2d, that a layer of sand, or earth, be occasionally spread over the surface of the dung. The former will prevent filtration, and the latter retain the gaseous matter, so useful in vegetation, and at the same time augment the quantity of manure. To prevent an excess of moisture, which always retards, and sometimes prevents decomposition altogether, the reservoir should be covered.

The *application* of manures, is a subject of more difficulty, and has given occasion to some disputation. The controverted points are:

1st. Whether short, or long dung, or in other words, whether dung thoroughly rotted, or that which has but began to rot, is most advantageous?

2d. Whether dung used superficially, or ploughed deep into the ground, is most profitable?

3d. Whether extraneous matters admitted into the stercorary, are useful or otherwise?

4th. Whether stable manures are best applied, directly or indirectly, to wheat crops?

5th. At what time manures are best applied? and,

6th. in what quantity?

We shall discuss these points, separately and briefly—and,

1st. Which is to be preferred, long or short dung?

The discordance in practice, as well as in opinion, prevailing on this question, induced some scientific men to institute a series of experiments, having for object a full and regular solution of it. With this view, parcels of dung (long and short) were taken from the same stables, on the same day, and applied to crops of the same kind, growing on the same fields. The result was perfectly conformed to theory, and similar in all the experiments. Those parts of the field, to which the short dung was applied, gave the best crops the *first* year, but those on which the long dung had been laid, gave the best crops the *second* and *third* years; a fact, which authorizes the conclusion, that if we wish to obtain *one* great crop, the rotted dung is best; but when we look to more permanent improvement, the long dung is to be preferred.

2d. Which is the better practice, to spread manure on the surface, or lay it deeply under the ground?

In favor of the former practice, it has been contended, that the distribution of the dung could more equally be made on the surface, with a spade, than under ground, with a plough; (1) and for the latter, that all tap rooted plants, entering far into the earth, required it to be laid deep, and that those of fibrous roots, would be sufficiently benefitted by its exhalations. Both modes, however, are obvi-

(1) The English (are said) to have a machine attached to the drill, that goes before and distributes the manure at the necessary depth. In planting potatoes, we make a bed of dung for the plant. Why not apply the same reasoning and the same practice to all seeding of the ground?

ously bad. We have seen, in the preceding article, that dung, to become the aliment of plants, must undergo a decomposition, and that to the production of this, the *combined* action of *air* and *water* is indispensable. But if the manure be buried deeply, this action cannot reach it, and the dung remains a *caput mortuum*. On the other hand, if spread superficially, the rains dissolve and carry away many of its juices, while the sun and wind evaporate the rest. These considerations lead to the true rule, on this head, which is, *to lay it three or four inches below the surface of the soil*. At this depth, (if short dung) its action will be most vigorous in all directions, and if long dung, a greater depth will, as already suggested, completely destroy all action.

3d. Are extraneous matters, as horns, hoofs, bones, shells, feathers, leaves, weeds, &c. &c. to be admitted into the dung heap?

There is, perhaps, nothing in either theory or practice, so obviously right that may not be disputed. The objection made to these matters, in mass, is, that they do not decompose equally, and that those ingredients of the heap, which are slowest in decomposition, retard others, which, if left to themselves, would, in this process, be more forward.—This objection is without weight; for we have seen, that long, or unrotted manure, though its effect be less prompt, is, upon the whole, more favorable to culture, than that which is rotted. The difference of time in decomposition, is, therefore, no evil, and the augmentation of the mass, is a great good; besides that some of these offals are the most power-

ful manures. Horns and hoofs are compounded of albumen and gelatine ; bones, of the phosphate and carbonate of lime and gelatine ; shells, of carbonate of lime and animal matter ; and feathers and hair of albumen, oil, &c. &c. Applied to the roots, they forward the growth of fruit trees more than any other species of manure.

4th. Whether stable manures are best applied, directly or indirectly, to *wheat* crops ?

The practice, on this head, is different in different places. In France, as in all other countries, where fallows are in use, the dung is applied directly to the wheat crop ; while in England, where the rotation system is established, it is applied to the summer crop, which immediately precedes that of the wheat.

The objection to the French practice is, that the weeds brought into the field by the manure, start with the grain, and do as much harm as the dung does good. Nor is there any sufficient answer, that I know of, to this objection. The English practice is, therefore, much to be preferred ; because, besides the advantage of exchanging a *fallow* for a *summer crop*, it permits you, while that crop is growing, to destroy the weeds that otherwise would have infested your fields.

5th. At what time of the year are manures best applied ?

The most approved rule, on this head, is to apply the winter dung wholly to potatoes, flax and corn ; that of the spring, to cabbages and beans ;

and what may be afterwards collected, to turnips:
And,

6th. In what quantity ought we to apply them?

The quantum of manure applied to the acre, must necessarily depend on the staple of the soil. If entirely exhausted of vegetable mould, a great deal will not be too much; but there is a possibility of erring, in this respect, even with regard to poor soils. Where an excess of manure exists, the crop (whatever it be) runs into stalk and leaf, and the effect on the flavor of the vegetable is bad; a fact which the experience of all who have tasted the cabbages and turnips raised in the *paudrette* of Paris and London, can abundantly establish. Even meadows (which are least liable to injury in this way) may be too much dunged. What cultivator, of observation, has not seen his cattle turn with disgust from herbage, the most luxuriant in appearance, but growing out of masses of manure? This circumstance suggests the advantage of going over our meadows in the fall and breaking up and distributing such lumps of dung as may be found in them.

The preceding remarks were confined to stable manures. What remains to be said applies to lime, marle, vegetable ashes, ashes of earth, and green crops ploughed into the ground.

It will be remembered, that the action of lime, as a manure, is owing to its *causticity*, or power of dissolving animal or vegetable substances; and to its quality of absorbing carbonic acid from the atmosphere. These properties render it peculiarly use-

ful in composts, or mixtures of dung, peat and earth ; a mass of which, disposed in alternate layers, is no doubt the perfection of this branch of husbandry.(1) It is also applied without any accessory, and with great advantage, to marshy grounds, to those having in them the remains of shell fish,(2) to natural meadows, and to all soils abounding in vegetable mould. On those of a different character it must be cautiously used as to *quantity*, and indeed, on any soil, an excess of it will completely destroy the fertilizing principle ; an effect constantly observed near mortar beds.

The *time* of using it, is liable to less uncertainty. On wheat, it should be sown as soon as the grain shows itself, and on meadows, late in the fall and after the cattle have been turned off.

Marle, being a compound of clay and lime, has the properties of the latter, and produces similar effects, but in a smaller degree. Hence it is, that the quantity of it given to the acre, is much greater than that of lime. The English practice is, to spread it over a field to the depth of three or four inches. This is done late in the fall, to the end, that frost and rain may break down and pulverise it.

The properties of *ashes*, whether derived from the combustion of animals, of vegetables, or fossile coal, are nearly the same, and resemble those of lime and marl. They powerfully attract and hold moisture and carbonic acid, and they hasten the decom-

(1) These might be formed in narrow lintals, inclining from the stable.

(2) There is much of this description of land on the bays and creeks of the Chesapeake.

position of stable manures, or other vegetable or animal product. Their action is most favorable on wet and cold soils, and as a top dressing to natural meadows and turnip crops.

The practice of *paring and burning the surface of the earth*, has been much used, and warmly recommended by the Irish ; and in their land of bogs, as in the marshes of Holland, where infertility arises from excess of vegetable matter, it may be useful ; but to burn the surfaces of sandy, gravelly, or even of dry clay soils, would be to lose sight of all sound theory.

Soils, in general, may be divided into two kinds, *sand* and *clay*. The defect of the one, is want of cohesion between its parts ; that of the other, an excessive, or superabundant cohesion. But vegetable matter is, as we have seen, a remedy for both ; and to accumulate this, is the constant endeavor of every enlightened agriculturist. Yet are we advised to destroy this vegetable matter by fire, and to substitute for it a small portion of ashes, as more favorable to vegetation than the soil itself ! But in what will these ashes differ from those found in our chimneys, and of which enough may be had ? In nothing, excepting that they may possess somewhat more alkaline salt ;(1) a circumstance which, if the

(1) De Saussure's experiments prove, that the stems of trees (other things being equal) produce less of this salt than the branches ; the branches less than the twigs ; and the twigs less than the leaves. M. Perthuys has formed a table of the relative alkaline products of plants and trees. By this table it appears, that the leaves and stems of Indian corn give by the quintal eight pounds thirteen ounces, the oak one pound five ounces, the pine five ounces,

sub-soil be not charged with oily and animal matter, will be more injurious than useful.

But, besides the consideration of getting so little, and that little of such equivocal character and use, what do we lose by the process? If we approach these little kilns, we find them emitting a black smoke, which cannot be entirely consumed: Our eyes and noses are assailed by some stimulating and ammoniacal matter, which is fast escaping, and which so far alters the atmospheric air in the neighborhood, as to render it difficult of respiration. Need we add, that *this* is the animal, oily and gaseous matter essential to the vegetable, and highly important to vegetation? It may be, that the ashes obtained may give one or two good crops of turnips; but even the advocates of this practice admit, that "*it ruins the land for an age; and hence it is that in England, tenants are restrained from paring and burning, especially towards the close of their leases.*"(1)

Clay burning is a different operation, and made with different views; not for the production of ashes or salts, which may operate chemically, but merely (by the application of heat) to alter the texture of the soil; to give to it an artificial division and porosity; to render what was cold warm, and what was wet dry; what was compact granular. But a small degree of heat will not produce these effects; for unlike the stems and roots of plants, clay is not itself combustible; and to bring it to the brick state, the heat applied must be long, continued and great:

(1) See Cobbett, part second, p. 168, "*Yeur's residence in the U. S.*"

hence it follows, that the practice becomes objectionable on the score of *expense*, and the more so, as *burnt clay* has no possible advantage over the much cheaper substances of sand, gravel and pounded lime-stone. The operation of *all* is merely *mechanical*, and exactly in proportion to the quantity used.

Our partiality for *green crops*, ploughed into the ground as manure, has been sufficiently indicated, and it is now only necessary, that we mention the *plants* best calculated for this purpose. At the head of these we place *buckwheat*, as well on account of *cheapness* as *effect*: *cheapness*, because the price of the seed (which is the only additional expense) is below consideration; and *effect*, because this plant, while growing, (from its umbrageous form) is a great improver of the soil, both by stifling weeds and preventing evaporation; and when ploughed into the ground, none decomposes more rapidly, nor has any a more powerful effect in keeping the earth loose and open to the action of light, heat, air and moisture, all of which are indispensable to vegetation.—“I know no plant, (says Rozier, the great French agriculturist,) that furnishes a better manure, or which is sooner reduced to vegetable mould, than buckwheat. When cultivated with this view, the usual quantity of seed ought to be increased, and the time of sowing hastened, so as to enable you to have two crops of manure the same season, and *before* the sowing of wheat.

The *lupin* (one of the leguminous family) has been long and profitably employed as a manure in Spain,

Italy and the southern provinces of France. Columella directs, that "it be sown in September, about the equinox, so that it may attain, before winter, a growth that will enable it to resist *wet* and *frosty* weather, which it particularly dreads." I need not remark, that these directions are not calculated for this climate, and that the seed time for the lupin *here* is the 20th of May. The properties which recommend it as a manure, are nearly the same as those which belong to buckwheat. It is a quick grower, and has many and large and succulent leaves. While growing, it subsists principally upon the air, and when buried, decomposes entirely and rapidly.

The *pea tribe* has the next place in this list; but though not better adapted to the end than buckwheat or lupins, is more capricious than they, and requires a soil of better staple and more preparation. The seed is also more expensive. Of this tribe, the *yellow vetching* (*lathyrus pratensis*) is the species to be preferred.

Turnips have been cultivated in England with the same view, but the practice has yielded to another and better; (which, however is not suited to our climate,) *feeding them off in the winter and on the field.*

SECTION VII.

Of Tillage, and the principles on which it is founded.

TILLAGE has three objects:—1st, the raising of plants, whose seeds, stems or roots may be necessary or useful to man and the animals he employs;—2d, the improvement of the soil, by laying it open to those atmospheric influences which increase its fertility;—and 3d, its destruction of weeds, or plants which rise spontaneously, and are either altogether unfit, or fit only in a small degree, for the nutrition of men and cattle, and which, if left to themselves, would stifle or starve the intended crop.

In fulfilling either or all of these objects, it is evident that the surface of the earth must be broken and divided into small parts, so that in the first instance it may furnish a bed and covering for the seeds sown, enable them to push their roots into the soil, and draw from it a portion of their subsistence.

To accomplish this leading intention (the division of the soil) various *means* have been employed. Fossil, animal and vegetable manures, as well by their mechanical action, as by their chemical properties, promote it; as do sand, pounded limestone and water (as in the culture of rice;) but it is to the *spade* and the *plough* we must look for that degree of efficiency, without which the earth would have remained a desert, or would become one. Of these, where the scale of labor is small (as in *garden cul-*

ture) the former is to be preferred; but in *farming*, the greater expedition of the latter gives it a decided advantage. Our remarks, therefore, will be confined to the operations of this instrument, and particularly to such of these as have given occasion to differences in opinion among practical farmers.

1st. *At what season of the year (spring, summer or fall) is ploughing best performed, in relation to a division and improvement of the soil and the destruction of weeds?*

The more scientific opinion is in favor of *fall* ploughing; because to the action of air and moisture, it adds that of *frost*, whose sceptic or dividing quality is second only to that of the plough itself. In clay soils, this preparation should never be omitted; because on those the action of frost is greatest, and because one ploughing of *this* kind may save two in the *spring*, when time is every thing.(1) In this operation, however, we must not forget to *ridge*, as well as *plough*; and care must be taken that our furrows have sufficient declination to carry off surplus water. With these precautions, your clay ground will be ready early in the spring for another ploughing; and the decomposition of the sod and weeds (turned down in the fall) will be nearly, if not altogether, complete.(2)

In dry and warm soils, these advantages are less,

(1) The *Marsh bean* grows best on a *fall ploughing*; and *oats*, well harrowed, will (on such ploughing) give a good crop without other culture.

(2) Without water there is no *decomposition*, and much water checks and prevents it.

but still, the time gained for spring work is a sufficient inducement to a practice that economises, not merely our labor, but the productive powers of the earth also, by soonest enabling us to shade the soil with a growing crop.(1)

2d. *What number of ploughings, preparatory to a crop, is necessary or proper ?*

The Romans were in the practice of multiplied ploughings. This appears, as well from the precepts of Cato, as from the opinion of Columella, that "tillage, which does not leave the earth in a state of dust and render the use of harrows unnecessary, has not been well performed." Tull, and his disciples, carry the doctrine still further, and believe that frequent ploughings enable us to dispense with even the use of manures. This, however, is extravagant: it is certain that the plough can do much, but it is equally certain that there is much it cannot do.

Agricultural, like other business, having profit for its object, is a subject of calculation: its labor must be regulated by its end, and the moment the expense of this transcends the profit, it may be *improvement*, but it ceases to be *farming*. When, therefore, we hear of *six* ploughings, preparatory to a wheat crop, we conclude, either that the plough will soon stop, or that it belongs to one of the Dilettanti, who thinks it below him to count the cost. In our own prac-

(1) Those who have any doubts about the importance of *shade*, have but to look at the effects of a brush heap, or other collection of small bodies, admitting air, heat and moisture, during the spring or summer months. Under such collections he will find a much more vigorous vegetation, than in the uncovered parts of the field: the cause of this effect is, that the brush prevents *evaporation*.

tice, we find that spring crops (of the cereal gramina) succeed best on one fall ploughing, well ridged and furrowed, and one cross ploughing in the spring; and that spring and summer crops, of the leguminous and cruciform families, form the best possible preparation for winter crops, and render unnecessary more than one additional ploughing. After all, any proper answer to this question must necessarily be qualified by considerations of soil, weather, season, crop and culture; influences which cannot but exist in all cases, and over which we have no control. Wheat, for instance, requires more *preparatory* ploughing than rye, and rye more than oats. Clay ground demands more tillage than calcarious earth, and calcarious earth more than sand. Wet or dry weather makes frequent ploughings (according to circumstances) either useful, injurious or impracticable; and the shade of a horse hoed crop is, perhaps, in itself, of more importance to that which succeeds, than would be the fallowing of a whole summer.

3d. *What depth of ploughing is most to be recommended?*

This question, though less complicated than the last, requires, like it, an answer qualified by circumstances. *Tap-rooted* plants require deeper tillage than others: *fall ploughings* may be deeper than those of *spring*, and *spring*, than those of *summer*. If the vegetable soil be deep, deep ploughings will not injure it; but if it be shallow, such ploughings will bring up part of the *sub-soil*, which is always *infertile*, until it receive new principles from the atmosphere. "They who pretend," says Arthur Young,

“that the underlayer of earth is as proper for vegetation as the upper, maintain a paradox, refuted both by reason and experience.”

Where, however, it becomes part of your object to increase the depth of the surface soil, deep ploughing is indispensable; and in this, as in many other cases, we must submit to present inconvenience for the advantage of future benefit. But even here, it is laid down as a rule, that “*in proportion as you deepen your ploughings, you increase the necessity for manures.*”(1)

“From six to eight inches, may be taken as the ordinary depth of sufficient ploughing.”(2) And,

4th. *Of the different modes of ploughing, [level or ridge ploughing,] which is to be preferred?*

This question admits no *absolute* answer. We have already suggested the use of the latter mode, in stiff, heavy, wet clays, and, in our opinion, all ground in which clay predominates, whatever be the culture, should be made to take this *form*; because it powerfully tends to drain the soil and carry off, from the roots of the growing plants, that superfluous water which, left to itself, would seriously affect both the quality and the quantity of their products.(3) In sandy, porous, dry soils, on the other hand, *level* ploughing is to be preferred, because *ridging* such soils would but increase that want of cohesion, which is their natural defect.

(1) Young.

(2) Idem.

(3) It has been objected to *ridge* ploughing, that it accumulates the good soil on the crowns of ridges, and impoverishes the sides and furrows. These objections are obviated by narrow and low ridges, which alternate, every crop, with the furrows.

A *loamy soil*, [which is a medium between these two extremes,] ought, in a dry climate, to be cultivated in the *flat* way, that it may the better retain moisture; and in a wet climate, in *ridges*, that it may the sooner become dry.

SECTION VIII.

Of a Rotation of Crops, and the principles on which it is founded.

To this branch of our subject, we invite particular attention; because, in our opinion, it forms the basis of all successful agriculture. Whatever pains we take, whatever expenses we incur, in collecting instruments of husbandry, in accumulating and applying manures, and in tilling the earth; all is to little purpose, unless to these we superadd a *succession of crops, adapted to the nature of the soil—to the laws of the climate, and to the physical character and commercial value* of the article raised. Peas will vegetate on wet cotton and wheat in pure sand; Indian corn will grow in high northern latitudes, and the apple may be found near the equator. We have seen sanfoin, struggling in wet clay, and aquatic plants on the top of an arid mountain; but all indicated the violence done to nature, and presented only specimens diminutive in bulk and deficient in quality. The influence of markets, on the value of produce, is as little to be denied, as

that of soil and climate. In the neighborhood of great cities, *table* vegetables are of much more value than wheat or rye ; but remote from markets, wheat and rye have the advantage, because being more valuable, in proportion to bulk and weight, they bear better the expense of transportation.

With this general view of the subject, we proceed to examine, 1st, the practice of Europe ; and 2d, the rotation best adapted to our own soil, meridian and markets. And,

1st. Of the practice of Europe :

It was long since discovered, (1) that the soil, when left to itself, was never either exhausted or tired or idle ; but that however stripped or denuded by man and the animals he employs, it hastens to cover itself with a variety of plants, of different and even opposite characters ; that some of these have a tendency to render the earth more compact, while others have the effect of opening and dividing it—that some, (from a peculiar structure of roots, stems and leaves) derive most of their nourishment from the earth, while others, differently formed, draw their's principally from the atmosphere : and lastly, that in these voluntary products, there is a continual and nearly regular succession of plants differently organized. These observations, carefully made and no longer doubted, and others leading to the same or similar conclusions, first suggested the usefulness of taking nature as our guide, and

(1) Virgil, who was a philosopher as well as a poet, appears to have thoroughly understood this branch of natural history : “ *mutatis quiescunt fatibus arva* ”—the true repose of the earth is in a change of its productions.

of conforming our *artificial crops* to the rules which obviously governed her *spontaneous productions*. The effect was such as was expected, and for more than half a century, the rotation system has formed the true test of agricultural improvement, in every variety of soil and climate. Whenever it has been adopted, the art is found in a state of prosperous progression; whenever neglected or rejected, it is either stationary or retrograde. Yet in the face of a fact, carrying with it such conclusive evidence, the bulk of agriculturists continue to resist this cheap and obvious means of improvement, and pertinaciously adhere to a system (that of fallows) which condemns to annual sterility, one fourth part of the earth, and even prefers four months unproductive labor, to abundant harvests and nutritious crops! But from this display of folly, let us turn to one of wisdom.

On the rotation system, the whole *arable* part of a farm is divided into four, six or eight fields, and subjected to a course of crops, denominated (according to the number of these divisions) the short, the medium, or the long course. In constructing these courses, however, whether long, middling or short, the utmost attention is paid to the nature of the soil, viz: In all soils more wet than dry, more compact than porous, more hard than friable, the course is made up from the following plants: *wheat, oats, buckwheat, the gramineal grasses, beans, vetchlings, clover, cabbages and chicory*. In soils of an opposite character (dry, porous and friable) the

plants, from which to choose, are *rye, spells, barley, potatoes, turnips*(1) *lupins, Indian corn, clover, san-foin*, and many of the pasture grasses. In loams, (which are nearly an equal mixture of sand, clay and decomposed vegetables) the choice of plants is much enlarged; embracing what is more peculiarly proper for both sand and clay, and having, besides, the following plants from which to select: *Rice, millet, sorghum* (African millet) *lucern, indigo, cotton, hops, tobacco, madder, hemp, flax, &c. &c.* The following cases will sufficiently illustrate the principles on which they rest, viz: *Never to select for a crop, plants not adapted to the soil; and never, in any soil, to permit two crops of the same species, or kind, to follow each other.*

2d. *Of the rotation best adapted to our own soil, meridian and markets.*

Previously to entering upon this subject, it may not be amiss to glance at the practice hitherto prevalent among us. What this was, in 1801, may be seen in the answer of an English gentleman and traveller, (Mr. Strickland,) to certain queries of the British board of agriculture, in relation to the state of husbandry here. After remarking that New-England was not a *corn country*, and had little to do with the *plough*, and that New-York was then, and would continue to be, the granary of America, he proceeds to divert his British readers with the fol-

(1) We here speak of the white turnip. The *Ruta Baga*, or Swedish turnip, is classed by French agriculturists among the products of strong substantial clay soils. In the next section we shall speak of the culture of some particular plants, and among these, of the Swedish turnip.

lowing details. "The usual course of crops in this state, (N. Y.) is first year, maize, (Indian corn :) second, rye or wheat ; third, flax or oats, and then a repetition of the same, as long as the land will bear any thing ; after which it is laid by to rest. A Dutchman's course, on the Mohawk, is, first year wheat ; second, peas ; third, wheat ; fourth, oats or flax, and fifth, Indian corn. In Dutchess county, the rotation is, first, wheat ; second and third, pasture without seed, and fourth, Indian corn, or flax, or oats, or mixed crops." Jersey, Pennsylvania, Delaware and Maryland, may be classed together, from a resemblance of climate, soil and mode of culture ; and here we have, "first year, Indian corn ; second, wheat ; third and fourth, rubbish pasture. Clover is, however, beginning to be introduced, in some such course as the following : first, wheat ; second, Indian corn ; third wheat ; fourth and fifth, clover.

Two exceptions are, however, taken to this system, 1st. In the German settlements in Pennsylvania, where, from more attention or more skill, "the wheat crop averages *eighteen* bushels to the acre, where *twenty-five* bushels are frequent, and instances of *thirty* not wanting : and, 2d. In the peninsula of Maryland and Delaware, where the rotation of Indian corn, wheat and rubbish pasture, has reduced the average produce to *six* bushels per acre ; in some instances not more than *two* bushels are obtained, and *much is so bad as to be ploughed up again.*"

"In Virginia the usual crops are, Indian corn and wheat, alternately, as long as the land will produce

them; and in parts where tobacco is cultivated, several crops of it are taken, in succession, before any grain is sown. No one states the average of that extensive flat country in Virginia, lying below the head of tide water, at more than *five* or *six* bushels; and in those fertile and beautiful vallies, among the mountains, in which ignorant cultivators have not yet resided sufficiently long to have entirely exhausted the soil, the produce may not be less than *twelve* bushels the acre."

These specimens of agricultural skill will not be adduced as proof of the favorite national position, that "*we are the most enlightened people on the face of the globe,*" and the less so, as a lapse of eighteen years had not entirely weaned us from ancient habits; for neither on the Maryland peninsula, nor in eastern Virginia, is there any material alteration in their mode of culture, excepting what may have arisen from the fact, that having no more fresh land to exhaust, they are now obliged to recur to *old field*, and are, of course, annually suffering the new and increased penalties of former improvidence. On the western shore of Maryland, in the northern parts of Delaware, and in Pennsylvania, New-Jersey and New-York, the state of things is better; clover has been substituted for (what Mr. Strickland calls) rubbish pasture, and the root husbandry is encroaching on summer fallows; which we regard as a decisive step towards a regular and judicious rotation of crops.

After this brief statement of the past and present state of home agriculture, let us anticipate the future. We cannot believe, that favored as we are with a temperate climate, with a productive soil, with an enquiring, reflecting and independent yeomenry, and with civil institutions which favor and protect all the developements of industry and genius, we shall long remain behind the serfs of Tuscany, the tenants of England, or the peasants of Flanders. But to rival these, we must follow their example; we must multiply the means of subsisting cattle; because these will, in their turn, give manures, and manures will quicken and invigorate the soil for the production of articles of the greatest value and the highest price. It is on this simple basis that we offer the following tables of rotation of crops, adapted to our own circumstances.

Medium course in sandy soils; 1st year, potatoes dunged; 2d, rye, with turnips after harvest consumed on the fields; 3d, oats and clover, or barley and clover; 4th, clover; 5th, wheat, with turnips after harvest consumed on the field; and 6th, peas, or lupins, or lentils. We have, by this course, *eight* crops in *six* years, and five of these ameliorating crops.

Medium course in loamy soils; 1st year, potatoes dunged; 2d year, wheat, with turnips as in the preceding course; 3d year, Indian corn and pumpkins; 4th year, barley and clover; 5th year, clover; 6th year, wheat and turnips as before. In this course we have *nine* crops in six years—five of which are ameliorating crops. And,

Medium course in clay soils ; 1st year, oats with clover ; 2d, clover ; 3d, wheat ; 4th, beans dunged ; 5th, wheat ; 6th, the yellow vetchling.

SECTION IX.

Of the Plants recommended for a course of Crops, in the preceding section, and their culture.

THESE are wheat, rye, barley, Indian corn, oats, buckwheat, peas, beans, turnips, potatoes, cabbages, clover and chicory : but we shall take them in the order in which they stand in the proposed rotation of crops ; and,

I. *Of the potatoe.*

This plant is a native of America, and like other valuable things, has had violent enemies and zealous friends. When first introduced into France, it was subjected to the imperfect methods of analysis of that day, and being supposed to yield some deleterious matter, was even proscribed by the government. But time, which rarely fails to do justice to the injured, has re-established it *there*, and with the increased reputation of being the “*manna of the poor*,” (1) of standing as an article of food, next to bread, (2) and far before cabbages, carrots or tur-

(1) Dictionaire de L'Industrie. Art. Pomme de terre.

(2) Experiments of Vaugelin and Percy, 80 parts out of 100 of bread are nutritive, of the potatoe 25, or nearly one fourth.

nips ;(1) and of yielding, by the acre, a crop of greater profit and more nutritive matter than either wheat or barley.(2) Nor is this its whole praise ; for, besides its value as food, it is of all vegetables that which, from the number, shape and size of its roots, forms the best preparation for subsequent crops.(3) Of this valuable plant, botanists count more than *sixty varieties* and *twelve species*, which, for agricultural purposes, may however, be reduced to *three* ; the red, the white, and that called by the French the *quarantaine*, or forty days potatoe.—The last is the least prolific ; but may, notwithstanding, deserve the preference with cultivators near great cities ; because, besides being the first in the market, they may be made to give a second crop. The other two are supposed to affect different kinds of soil ; the red preferring clay ; and the white sand or loam. Of the former, there is a variety, more productive than any other of either species, and which is known (and we think degraded) by the name of the *hog potatoe*. Of this variety, without any peculiar care, we have raised one hundred and eight bushels on one quarter of an acre.

Two ways are employed to propagate the potatoe ; 1st, by sowing the seed ; and 2d, by planting the root. By the former method, we obtain new varieties, or revive old ones ; but as it requires three

(1) "6 Killogrammes de pommes de terre equivaloiant 50 killogrammes de navet." Yvert.

(2) 200 bushels, a medium crop per acre of potatoes, are, at 3s. per bushel, equal to seventy-five dollars ; and a medium crop of wheat, 15 bushels per acre, at even 16s. per bushel, is but 30 dollars ; difference per acre, \$35.

(3) Parmentier of the French Institute.

years to bring these to maturity, it follows, that the other method, which continues the species you plant, and in the perfection in which you plant them, is alone resorted to for a crop. The product is small or great, or enormous, according to the fertility of the soil and the labor bestowed upon its cultivation. We have never seen a larger product from the acre, than four hundred bushels ; but there are records of high authority, which give much larger crops, and from which, in justice to our subject, we offer the following extracts.

“ At Altingham, in England, a sandy soil gave “ 700 bushels per acre. At Kirkclatham, a similar “ soil gave 580 bushels ; and a black rich loam, 1166 “ bushels.”(1)

We need hardly remark, that such immense products were procured only by the most careful and well timed cultivation ; which we shall now proceed to indicate, under three different heads. 1st, the preparation of the soil ; 2d, the choice of plants and mode of planting ; and lastly, the treatment of the growing crop.

1st. Of the preparation of the soil.

Give your field, intended for potatoes, a good fall ploughing, and in ridges, if the soil be clay.— Leave it rough and open to the influences of the frost, during the winter, and as early in the spring as you discover in it the mark of vegetation, har-

(1) See vol. 13, p. 114, of the British Annual Register. Some persons have imagined that by cutting the flowers of the potatoe, the crop may be increased, and analogy forms the opinion. The procreative powers of the plant are thus diverted from the apple and concentrated in the bulb.

row and roll it. When the weeds show themselves a second time, carry out your manure, cover the fields with it and plough it under. If the quantity of manure be insufficient to cover the whole surface, apply it to the furrows only ; and if, as may happen, it be even insufficient for this purpose, then furrow both ways—manure the angles of intersection, and set your potatoes in them.

2d. Of the choice of plants, and mode of planting.

Some economists begin by pairing the potatoe, and planting only the skins ; others, less saving, cut the potatoes into slices, leaving a single eye to each slice ; and a third class, almost as provident as the other two, are careful to pick out the dwarfs, and reasonable enough to expect from them a progeny of giants. These practices cannot be too much censured, or too soon abandoned, because directly opposed both by reason and experience. In other cases, we take great pains, and sometimes incur great expense, to obtain the best seed. In the cultivation of wheat, we reject all small, premature, worm eaten, or otherwise imperfect grains ; in preparing for a crop of Indian corn, we select the best ears, and even strip from these the small or ill shaped grains at the ends of the cob ; so also in planting beets, carrots, parsnips and turnips, the largest and finest are selected for seed. The reason of all this is obvious :—Plants, like animals, are rendered most perfect, by selecting the finest individuals of the species, from which to breed. Away then with such

miserable economy, and instead of planting skins, or slices, or dwarfs, take for seed the best and largest potatoes ; (those having in themselves the most aliment for the young plants;) (1) place them in your furrows, ten or twelve inches apart, and cover them carefully with earth.

3d. Of the treatment of the growing crop.

As soon as the potatoes begin to show themselves, weeds will also appear ; a good harrowing will then save much future labor, and the injury it does the potatoe will be little or none. In a short time, another weeding will become necessary ; but your crop having now obtained some inches in heighth, you can no longer safely use the common harrow ; but instead of this, the small one of triangular form, so made as to accommodate itself to the width of the intervals. This labor may be occasionally repeated, if necessary, until the potatoes begin to flower, when the *horse hoe* must be substituted for the harrow. The effects of this instrument (the horse hoe) are to extirpate the weeds, to divide and loosen the soil, and to throw over the potatoes an additional covering of earth.

The harvesting and preserving of potatoe crops, are processes well known in this country. With regard to the latter, however, we would suggest, whether stacking potatoes on the surface of the soil and with a narrow base, is not a better mode than burying them in the ground. Fifteen bushels will be enough for one stack, which must be well cover-

(1) The interior of the potatoe, forms the *fecula*, which subsists the young plants.

ed with straw and earth, and trenched around its whole circumference, to carry off dissolving snows and rain water.

II. Of Rye.

This grain, though of the same family with wheat, is less valuable. A bushel of rye weighs less, and gives less flour, and of worse quality, than a bushel of wheat. In comparison, therefore, with wheat, it fails; still there are circumstances, which, as an object of culture, may give it the preference—1st, it grows well in soils where wheat cannot be raised; 2d, it bears a much greater degree of cold than wheat; 3d, it goes through all the phases of vegetation in a shorter period, and of course exhausts the soil less;(1) 4th, if sown early in the fall, it gives a great deal of pasture, without much eventual injury to the crop; and 5th, its produce, from an equal surface, is one sixth greater than that of wheat. These circumstances render it peculiarly precious to poor soils and poor people—to mountains of great elevation and to high northern latitudes.(2)

Its use, as food for horses, is known as well in this country as in Europe. The grain chopped and the straw cut and mixed, forms the principal horse food in Pennsylvania; and in Germany, the postilions are often found slicing a black and hard rye bread, called *benpournikel*, for the post and other horses; and the same practice prevails in Belgium and Holland.

(1) We have seen a field bear rye several years in succession, without manure, and the last crop was much the best. This fact is one of those, which tend to discredit theory.

(2) Without rye a great part of Russia would be uninhabitable. What we have seen of Archangel or Russian rye, is a miserable specimen—black and light.

Its conversion into whiskey, is a use less approved by reason and patriotism; but if a spirituous liquor must be drank, we have no scruple of preferring the form of whiskey, (of our own making,) as that, which, on the whole, is least injurious to the human body, and most beneficial for the body politic.

The species of this grain, cultivated here, are two; the *black* and the *white*; for spring rye, [often mistaken for a *species*] is but a *variety*, produced by time and culture, and restored again to its former character and habits, by a similar process.(1)

According to the course of crops, detailed in our last section. potatoes, in a sandy soil, precede rye. The ploughing, harrowing and manuring given to *that* crop, will therefore make part of the preparation necessary for *this*. After harvesting the potatoes, cross plough the ground and sow and harrow in the rye, taking care, as in all other cases, that the seed be carefully selected and thoroughly washed in lime water, as the means best calculated to prevent the *ergot*; a disease, to which it is most liable, and which is supposed to be an effect of too great humidity.(2)

Rye is not exempt from the attacks of insects; but suffers less from them than either wheat or barley. Whenever the straw of winter rye becomes yellow, shining or flinty, and circulates no more juices, nature makes the signal for harvest, and no time should

(1) Spring rye, sown in the fall, will give a tolerable crop; winter rye, sown in the spring, a very bad one: which shows, that the nature of the plant requires a *slow*, rather than a *quick* vegetation.

(2) See Tessier on the diseases of plants.

be lost in obeying it. "*Cut two days too soon, rather than one day too late,*" was among the precepts of Cato; which, if adopted here, would save much grain—terminate the harvest about the tenth of July, and give abundant time to turn down the stubble, and sow the crop next in succession.

III. *Turnips.*

These are said to be natives of the sea coast of the north of Europe, where they are found growing spontaneously. There are of them eight species, and many varieties; but as they have the same character and uses, and require nearly the same treatment, we shall only speak of the *white* turnip and the *yellow*.

Two methods of cultivation have been pursued, according to the plan, either of turning them down as manure, or of consuming them on the field, or in the stable, by sheep or cattle. In the first case, the harrow is used instead of the plough; and even upon light porous soil, is a pretty good substitute. The seed is sown after the harrow, and but too frequently left to its own protection. In the other case, the plough is first used, and after it the harrow; a method much to be preferred, as the difference of crops will more than pay the difference of labor, the only advantage claimed by those who advocate and adopt the first method.

Our own practice is to plough in the stubble, harrow the ground lightly, and sow the turnip seed in the quantity of two pounds to the acre. This allows something for insects and something for waste. When the plants are generally above ground, give

them a light covering of ashes, which, by quickening the growth of the plants and leaching on their leaves at the same time, better protects them against the fly than any other means practicable on a large scale, with which we are acquainted.(1) When the plants attain the height of four inches, we set the horse hoe to work; running a furrow the whole length or breadth of the field, and returning with another, at the distance of three feet from the former, and so continuing the work, till the whole is laid off into beds of that width. What we lose by this method, is only the seed buried by the horse hoe; what we gain, is the manure created by the young plants, ploughed in between the beds, and the advantage of being able to weed and work those left standing for the crop. This part of the labor, which immediately follows the horse hoeing, is expeditiously performed by two men, travelling in the furrows, one on each side of a bed, and employing themselves in thinning and hand hoeing the surplus plants. These operations of ploughing and weeding, may be performed a second and even a third time, with advantage.

If we determine to plough in the crop as manure, we should do it while the ground retains a temperature favorable to the decomposition of the plants, and before the frost has diminished their volume, or altered their juices. If, on the other hand, we decide on feeding off the crop on the ground, it is but

(1) On a small scale, water, in which potatoes have been boiled, is believed to be very useful in protecting cabbage, turnips and other plants, from the attacks of the fly. We are in a course of experiments, which will determine how far this remedy may be relied on.

necessary to turn in your sheep upon it, under such restrictions as will limit their range, and prevent waste; and, indeed, that nothing should be lost, hogs should be made to follow the sheep. If, however, feeding in the stables be thought more advisable, (and it certainly better economises both food and manure) the turnips should be drawn, topped and stacked; interposing between each layer of them, one of coarse hay or other barn rubbish, and capping the whole with a few bundles of clean long straw. Though less nutritive than either potatoes, carrots or cabbages, the turnip is found to be particularly useful to stall fed cattle, correcting, by its aqueous qualities, the heating effects of corn, oats or rye meal.

Our acquaintance with the yellow turnip, (or *ruta бага*) is but beginning. Mr. Cobbett's experiments have, however, been very successful, and tend much to recommend the plant, in preference to the white or common species. That, of the two, it is the more compact, the heavier, the more nutritious, the less apt to become stringy and the more easily preserved, are facts not to be contested. In both France and England, it is rising in reputation, and perhaps wants only time to get into general use here. To this article we will but add an extract from the work of M. D'Edelcrants, (of Sweden) on the *ruta бага*.

"Its root is milder and more saccharine than that of the other species, particularly when boiled. Its flesh is harder and more consistent; which better enables it to withstand frosts, and to keep from one

year to another. Its leaves extend horizontally, and may be stripped off from time to time, as wanted for forage, without injuring the product of the root; which (in good soil) gives, on the acre of Sweden, 350 quintals, and, in even poor soil, a good crop. We sow half a pound of seed, about the beginning or middle of May, which will give plants enough to fill an acre. Transplanting is performed about the last of June or first of July. To set out and water 5 or 600 feet in a day is the task of one man, or of two women. One or two hoeings augment the product much. The harvest is made about the first of November, and the turnips are covered in ditches, or in dry caves or cellars, for winter use."

IV. Of Barley.

It is probable that bread was first made from this grain. The Jewish scriptures speak only of *barley loaves*; the gladiators among the Greeks were called *barley eaters*; and Columella says, that (like our Indian corn and beans in the southern states) barley was the food of the *slaves*. Among the Romans, it was first employed as a food for man, and afterwards for cattle. (1) The same qualities which recommended it then, have since diffused it more generally than any other grain; it is found to be better adapted to different soils and climates; less subject to the attacks of insects, and more easily preserved. In times of scarcity, it is a good substitute for wheat, and at all times yields a beverage, under the names of beer, ale or porter, equally

(1) This use grew out of the belief of its nutritive and invigorating qualities,

wholesome and invigorating. It is, besides, a food on which cattle do well, and horses arrive at their greatest possible perfection.(1)

The *species* of this grain most in request, are two—*Hordeum Distichum* (two row barley) and *Hordeum Celestæ* (naked barley.) The former is preferred in England, and as we suppose in France. M. Parmentier ascribes to it all the good qualities of the other species, and much more productiveness.(2)

Of the latter species, the nations of the north, who are most in the habit of using barley as the basis of both food and drink, speak highly.(3) But among us, who cultivate it only for the last purpose, this species has less credit, and is even considered the worst, from a belief, that after being dried, it malts imperfectly or with difficulty.

Though not so nice in relation to soil, as either wheat or rye, still barley prefers a loose, warm and moist (not wet) soil, and even grows remarkably well in sand, (where we have placed it) in succession to turnips, either ploughed into the ground or consumed on the field.

Other things being equal, the spring crops which are first sowed, give the best and largest products. The moment, therefore, that your soil is sufficiently dry, begin ploughing, and at a depth not less than six inches; because the roots of barley enter the earth more deeply than those of any of the other

(1) See Buffon, on the horse of Arabia. Vol. xxii. p. 195.

(2) He states it to be *double as much*.

(3) "*Hordeum celeste Norvegis gratissimum, quoniam cerevisiam generosam, præbe.*" Mitterpacher. *Elemrei. rust.* page 312.

cereal graminæ. If the soil be well pulverised, [as it ought to be after turnips] a second ploughing would be a waste of time and money : (1) proceed, therefore, to sow your barley broad cast, (2) and cover it with a short toothed harrow. The last operation will be to sow and roll in your clover seed, destined to become the next crop in succession.

V. Of Clover.

The Frifolium Agrarium of Linneus, is found growing spontaneously in many places, as is sufficiently indicated by the names given to it—of Dutch clover, Spanish clover, clover of Pidmont, clover of Normandy, &c. &c. (3) It is about two centuries since it first became an object of agricultural attention as *forage*, while its *ameliorating effects on the soil* (produced by its peculiar system of roots and leaves) was a discovery of modern date. It is now generally sown with barley, or other spring grain of the culmiferous kind, and rarely by itself. The advantages proposed by this practice, are three : 1st, the preparation given to the soil for the grain crop, which is exactly that best fitted for the clover ; 2d, the protection given by the barley to the young clover, against the combined effects of heat and dryness ; and 3d, the improved condition in which it

(1) The Romans had two maxims on the subject of expense, which it would be wise in us to adopt : “ those profits are to be preferred, which cost the least ;” and again, “ nothing is less profitable, than very high cultivation.” “ Nihil minus expedit, quam agram optime colere.”

(2) Mr. Young's experiments shew, that there is something in the constitution, or habits of this grain, to which the drill, or row husbandry, is not accommodated. Even isolated grains, wed and worlled, did not do better than the same number in broad cast.

(3) A seed of Holland clover, of the same volume with one of Normandy clover, weighs one seventh more. See Gilbert on Artificial Meadows.

leaves the soil for subsequent culture. In this practice, however, a less quantity of barley must be sown than usual, because without ventilation, the clover plants will perish. To this condition two others must be added, because indispensable to a good crop: 1st, that your seed be good; and 2d, that it be regularly and equally sown. The tests of good seed are, its comparative size and weight, (the largest and heaviest being always the best) its plumpness, its yellow or purple color, its glossy skin, and lastly its cleanness, or separation from other seeds and from dirt.

The human hand was, no doubt, the first machine employed for sowing seeds. The difficulty, however, of scattering them equally over every part of the field, soon attracted notice and engaged mechanics in devising something which should better answer that purpose. China was the first to produce any thing at all commensurate with this object; and it was not till the seventeenth century that this, or some similar invention, was introduced into Europe by Lucateo, (a Spaniard,) who, meeting no encouragement at home, transmitted his real or pretended discovery to London. Here, (as has been conjectured,) it served as a model for the sowing machines of M. Tull, and from 1750 to 1770, the mania on this subject was at its height: but from that period to the present, it has been gradually subsiding, and the hand is now completely and generally restored to its original functions.

The quantity of seed to be given to the acre should, in a great degree, depend on the soil; if

this be rich, ten or twelve pounds are sufficient; and if poor, double that quantity will not be too much. The practice of mixing the seeds of timothy and rye grass, &c. with that of clover, is a bad one; because these grasses neither rise nor ripen at the same time. Another practice, equally bad, is, that of sowing clover seed on winter grain, before the earth has acquired a temperature favorable to vegetation, and when there cannot be a doubt but that two thirds of the seed will perish.

By the time your barley, or other covering crop, is harvested, your clover will be sufficiently established to live alone; and, *if not pastured*, (1) to brave the ensuing winter, and during the next summer to repay your labor by two abundant crops of grass or hay.

The period in the growth of clover, at which it is most profitably cut and used, presents a question much discussed and variously answered; because depending on extraneous and local circumstances, (such as the state and proximity of markets, &c.) which can not fail to vary the results, in the hands of different persons, and even of the same person, at different times and at different places. There are, however, some general remarks which belong to the case, and which ought not to be omitted in even this brief view of the subject.

1st. Clover cut *before* it flowers abounds in water—has in it but little nutritive matter, and is even

(1) If the *crowns* of young clover roots, be nibbled or otherwise wounded, the roots die. Sheep and horses (both of which bite closely) should therefore be particularly excluded from clover, unless intended for pasturage only.

apt to produce indigestions in the cattle fed upon it.(1)

2d. The stems of clover, cut *after* seeding, are hard and woody, and no longer hold the leaf: and,

3d. All plants, when permitted to seed, exhaust the soil; and to this rule clover is not an exception.

From premises furnished by these facts, we would conclude, that the short period between the flowering and seeding of clover, is that in which its use would be most advantageous, whether regarded as a *forage* or as an *ameliorating* crop.

When *seed* is the principal object of culture, we cannot do better than to adopt the practice in Holland—where the first crop is cut *before* it flowers, and the second is reserved for seed.

The largeness of the stems, the number of the leaves, and the aqueous quality of both, render it a difficult business to make clover grass into hay; and the difficulty is not a little increased, by the brittleness or disposition of the drying grass to fall into pieces, during the process of handling. To meet this case two supplementary means have been employed; which enable you to house or stack clover in a much greener, or less dry state, than would otherwise be safe. The one is, to scatter over each cart load, while stowing away for keeping, two or three quarts of sea salt: the other, to interpose between two layers of clover, one of clean straw. By the first method, the whole mass is made accepta-

(1) This effect of clover (which we call *hoving*) is prevented in Alsace, by watering the cattle before giving them clover, because a certain quantity of water prevents fermentation.

ble to cattle; by the second, the quantum of nutritive forage is increased—and by both methods the clover is effectually prevented from *heating*.

The next step, in our system, is to plough in the clover stubble, as a preparation for the succeeding crop.

VI. Of Wheat.

This grain, so useful to man, (because forming so large a portion of his subsistence) is happily found to adapt itself to a great variety of soils and climates. It grows vigorously in clay, in loam, in calcareous earth and even sand, when aided by manures, or in succession to peas, vetches, clover, &c. To the north it is found in the frozen regions of Siberia; and to the south, under the burning sun of Africa, it yields, according to the declaration of Pliny, more than one hundred fold.(1) In ancient Rome, its use, as a food for man, soon superseded that of barley and rye; and in modern Europe, it is even denominated *corn* par excellence.

Of this invaluable grain, there are four species, distinctly marked and generally acknowledged, viz. Many headed wheat,(2) Polish wheat, spelts and common wheat. We shall speak only of the third and fourth species, because with the others we have little practical acquaintance; and,

1st. Of *Spelts*. This species and its principal va-

(1) "Tritico nihil est fertilius: utpote cum e modio, si sit aptum solum, quale in Byzacio Africæ campo centuri quinquageni modii reddentur." XVIII L Nat. Hist. Pliny.

(2) This is the *Triticum Compositum* of botanists, called wheat of plenty, miraculous wheat, &c. yielding largely, but, on manufacture, giving much bran and bad flour.

riety (*Triticum Monicocum*) is much cultivated in Germany and Switzerland. Deprived of its husk, the grain is smaller than that of common wheat, but yields a flour of finer quality and better fitted for the purposes of pastry. (1) Two other circumstances recommend it; it withstands the attack of insects, and will grow in poorer soil and with less preparatory labor, than the fourth species.

2d. *Common wheat* has many varieties; some of which are bearded, and others bald; some oval and others round or square; some yellow or red, and others white; some soft and others flinty: accidents arising from culture and climate, and not, as we believe, the result of an organization uniformly and essentially different.

With regard to the culture of this plant, we shall confine ourselves to the following points;—the preparation of the soil, the choice and preparation of the seed, and the time and different modes of sowing or planting it.

1st. Of the preparation of the soil.

Products of much value to man, can only be obtained by corresponding degrees of labor. The sugar cane, rice and wheat, are more valuable than oats, buckwheat or turnips, and require more labor and expence in their cultivation. Indeed, under the old system of fallows, the degree of both, bestowed upon a wheat crop, was enormous. Two years and five or six ploughings were sometimes given to this preparatory culture; but on the new plan of a ro-

(1) The bread of Franckfort, Nuremberg, &c. so much boasted in Germany, is made from spelts.

tation of crops, the necessity for this, is in a great degree obviated, and two ploughings of a clover lay are in general amply sufficient. Still, this takes for granted, that these ploughings are well performed; that no clods are to be seen, and the field presents an unbroken surface of mellow and finely pulverised earth.

2d. Of the choice and preparation of seed.

Seed should be taken from some fine crop of the *preceding year*,⁽¹⁾ which shall have ripened thoroughly and been well preserved. This, after passing two or three times through the fanning mill, should be carefully washed in clean water, and again in water in which a quantity of fresh lime has been slacked; or (if lime cannot be had) in which clean and recent wood ashes have been leached. This washing, as we have already suggested, should never be omitted; because, besides detecting the shrunk or shrivelled grains, and many seeds of other plants (which will float on the surface of the water) it entirely removes the *dust* of *smut* and *rust*, &c. and thus prevents their propagation.⁽²⁾ Our next step

(1) A great variety of experiments shew, that wheat preserves its germinating faculties, under circumstances apparently very unfavorable, and that it may even be sown to advantage, after several years keeping, after a slight degree of mauling in the sheaf, or the stack, and after having been subjected to a high degree of artificial heat. We mention this fact, however, not to invite to a selection of seed grains, of either of these descriptions, but to assure the farmer, that where better cannot be had, he may employ such, for that purpose, without apprehending a total loss of his time and labor.

(2) *Smut*, *charbon* and *rust* in grain, were (according to the old philosophy) attributed to storms, or other particular state of the atmosphere; but Mess. Tillet, Tessier, B. Prevot and Decandolle have shown, that the two former of these diseases are produced by an intestinal parasite, of the *uredo* or mushroom family, the progress of which is much promoted by humidity and shade. Analogy favors the opinion, that *rust* owes its origin to the same cause. The remedy for all is the same;

in this process is to roll the seed in pulverised gypsum.

3d. Of the time of sowing wheat.

On this head there is a diversity both in practice and opinion. Some prefer early, others late sowing; some sow in the full, others in the wane of the moon, &c.

Theory is certainly on the side of early sowing—because it gives time for the roots of the grain to establish themselves before winter, and experience proves, that grain early sown, throws up more lateral stems, than that which is sown late.

Of lunar influences we know very little, excepting that they extend to the waves of the ocean; which has probably first begotten the opinion, (held by M. Toaldo and other *scavans*,) that the atmosphere (which is only another and more fluid ocean, and which has much to do with the health and diseases of animals and vegetables) is also subject to these influences. But the calculations of M. de Place prove, that the effect of these on the atmosphere, will not make a difference of one line and a half on the barometer, and are wholly insufficient to account for those great agitations of the atmosphere, which have been supposed most to affect vegetation.

4th. Of the different modes of sowing wheat.

These are two, the one executed with the hand, the other with a sowing machine of which we have already spoken. The latter has been advocated on

wash your seed grain thoroughly in lime water, roll it in plaster of paris and sow it in the fall, before the cold and wet weather begins, or in the spring after it has ended.

the ground of economy, employing less seed and distributing what it does employ more equally. Nor will it be denied, that when wheat is very high and labor very cheap, there may be a saving in the use of this machine; but in all other circumstances the comparison is in favor of the other method, as it requires less time and fewer laborers, and as the waste and irregularity imputed to it, are, in hands practised and steady, reduced to little or nothing.

A third method of propagating wheat, viz. by transplanting the suckers at regular distances from the seed bed, into another prepared to receive them, has been practiced on a small scale and is found to yield abundantly; but it is so embarrassed with expence as to render it entirely unfit for general use.

Of the produce of wheat very different accounts have been given. To the extraordinary fertility of Byzantium, already mentioned, Pliny adds, that in Leontium, in Sicily, its produce was one hundred for one; yet Cicero, who had been questor of that island, asserts, that the produce of Sicily was but ten or twelve for one.(1) To conciliate these high and opposite authorities, M. Yvart has supposed, that the product mentioned by Cicero, was an average one of the whole island; and that that reported by Pliny, was the result of one or more *transplanting experiments*; an opinion rendered probable from the fact, that the parent stems and their offspring had been sent to Rome by the procurator of Augustus.(2)

(1) Orat. contra Verrem.

(2) Misit ex eo loco, divo Augusto procurator ejus, ex uno grano (vix credibile dictu) cccc. paucis minus germina. Pliny.

Some calculators have supposed, and on data not easily refuted, that the maximum produce of this grain over the whole face of the globe, and in a series of any ten given years, will not exceed six bushels reaped for one bushel sown.(1)

VII. Of Peas.

The pea is a native of the southern parts of Europe, and is found growing spontaneously in the western parts of our own continent. The family is a large one, containing several species; but of these, the *field pea* alone comes within the scope of our present purpose. Of this there are two varieties, denominated, from their colour, the grey and the green; both productive, and (when separated from the skin that surrounds them) a food of excellent quality for man, wholesome, nutritive and pleasant: and for cattle, whether in a dry or green state, much to be recommended. Sheep, cows and horses are particularly fond of them; and hogs are more promptly and economically fattened on a mixture of pea and barley meal, in a state of acetous fermentation, than by any other food.

The structure of the roots would indicate, that peas are an exhausting crop; and it is on this evidence, that in Europe they are admitted only in long or six years rotations; but if we examine the leaves, in regard to both number and form, we will probably find reason to modify this opinion and allow, that by stifling weeds, by checking evapora-

(1) The reader will remember, that on our plan, turnips follow wheat, as they do rye, and without any difference in cultivation. See article 3d of this section. To repeat here what we have said there, would be useless,

tion, and eventually, by their own fall, they ameliorate the soil and render it more favorable to subsequent crops.

Following turnips, [as in the rotation we are now discussing] the preparatory labor for a pea crop, is not great. One, or at most two ploughings, will be sufficient. Sowing, as a general rule, ought to follow ploughing, without loss of time; and care should be taken, that the seed be not laid too deeply. The two methods, row and broad cast sowing, may be indifferently pursued. By the former, the seed is economised, the product increased, and the soil better tilled; but not, as some have supposed, with such decided advantage as to outweigh the saving, in time and labor, of the latter.

The length and feebleness of the stems of peas, and the little tendrils they throw out for support, indicate the advantage of mixing with them other plants of more erect growth, which may prevent the peas from falling and lodging. For this purpose, rye, oats, and beans have been selected, and with great advantage.

This crop is employed either in a dry or in a green state; between which every farmer will select, according to circumstances. If the market for peas be brisk and high, he will harvest, thresh and sell the grain; if, on the other hand, peas are low and pork high, the moment the pods fill, he will turn in his hogs upon them, and with the following advantages: 1st. The hogs feed and fatten themselves, without any additional interposition of his labor; 2d. No particle of their manure is lost; 3d.

The *debris* of the crop, refused by the hogs, is given back to the soil ; and 4th, the rooting of these animals, which in other cases is an injury, is in this a benefit.

VIII. Of Indian Corn.

This is a native of South America, and was introduced into Europe in the 16th century, where it is known by the names of wheat of Turkey, Indian wheat, Spanish wheat, &c.(1) Its productiveness and other good qualities, have brought it into general use, for it is now found in every part of the globe, where its cultivation is not forbidden by the coldness of the climate. With proper culture, it grows well in a great variety of soils; but prefers old and rich pasture grounds, artificial meadows, warm loams, and moist vegetable mould.

There are many varieties of this grain, denominated from colour, number of rows of the grain, and different periods of ripening. The *white* and the *yellow* (of 8 and 12 rows) are the varieties generally preferred.

Corn, from its bulk, its prolific character and system of roots, must necessarily be a great feeder, and draw much of its supplies from the earth; whence arises the rule, that it ought not immediately to follow, or to precede, any other gramineal crop; and that it be not found oftener than once in six years in the same field.

The seed should be taken from the finest ears of

(1) This is the *Zea* of the botanists. In what does this differ from the *Zea* or *Sesman* of the ancients? The favorite dish of the Romans was *Alica* and *Alica fit e zea, quam semen appellavimus.* Plin. 18 L. Nat. Hist.

the last year's crop, and from those growing on stems which have had the largest number of ears. After steeping it twenty-four hours in a strong solution of nitre, it should be planted.(1)

There is some difference of practice, without any great difference of result, *in the modes of planting*. Furrows are sometimes made, at the distance of three or four feet from each other, and in one direction only, and in these the seed is placed, fourteen or sixteen inches apart. At other times the field is furrowed both ways, and the seeds dropped and covered at the points of intersection; while again two rows of beans or potatoes, or mangel wurzel, are interposed between as many rows of corn. This last practice is most conformable to theory, but the other methods generally prevail, and pumpkins, beans or turnips form the under crops.

Whatever method be adopted, the *time* of planting is that at which the earth first acquires the warmth necessary to vegetation, and which is sufficiently indicated by her spontaneous productions. If we plant earlier, the seed is apt to rot; if later, the ripening of the crop is hazarded.

No crop while growing requires more attention than corn, and none better repays the labor bestowed upon it. The objects of this are two, to extirpate weeds and to keep the earth loose and open to the influences of the atmosphere. As soon, therefore, as weeds begin to show themselves, the surface of the field must be well harrowed. Plastering is the

(1) See in Judge Peters' Notices to young farmers, the effect of this solution on corn crops.

next operation, and may, at the distance of a few days, be repeated with advantage. The weeds will now re-appear, when the triangular harrow, accommodated to the width of the intervals, must be employed. This, drawn by a single horse, will do its work expeditiously and well. The plough called the cultivator, with a double mould board, follows the harrow, and is itself followed by the hand hoe, which alone can perform well the last and great operation of *hilling* the corn. The first effect of this is to enable the grain to form new joints near the surface of the earth, whence will issue lateral roots, fitted to receive an additional quantity of aliment necessary or proper for the plant.(1) Care must however be taken to flatten these little mounds of earth, so as to make them better recipients of water.

Corn is sometimes cultivated with a view only to the forage it may yield; in which case it is generally sown broad-cast, at the rate of ten bushels to the acre, and cut green, while its saccharine qualities most abound. We are told by Mr. Bosc, that in the volcanic soil of Vicenteri, in Italy, corn managed in this way, gives four crops in the year. As a dry forage, it is a great resource in warm climates, where natural meadows are rare, and artificial nearly unknown. In the eastern parts of Virginia, it furnishes the principal stock of horse fodder; and in our northern latitudes, is a useful supplement to clover, timothy and red-top hay.

(1) Bonnet was the first to make this observation, but if the reader wishes to see a full illustration of it, we refer him to the memoir of M. Varennes de Fenillis, who has proved, that the crop is increased 1-13th merely by hilling.

The produce of corn is much affected by weather. If this be hot and dry, the leaves, stems and ears are all diminutive ; if wet, the leaves and stems are abundant, but the ears deficient and often diseased ; if both wet and cold, no ears are produced ; and on the other hand, if moist and warm, (more particularly when the grain is flowering) the crop is excellent.—To produce this combination, is not within the reach of human industry. All, therefore, that agricultural foresight can effect, is to interpose a few days between the planting of different parts of the crop, so as to multiply the chances of favorable weather.

IX. Of Beans.

Of these, there are several species, which to occupiers of *clay* soils, are of the utmost importance, because in them the beans thrive best, while at the same time they greatly ameliorate and fit them for wheat and oat crops. The species most recommended, are the Heligoland or small horse bean of England, and the white bean. The former is vigorous, hardy and productive, and an excellent food for cattle ; the latter is more delicate and nutritive, and much employed as a food for man.(1)

If beans are made to commence a course of crops, as they may very properly do, they ought to receive the dung of the year, which, as in the case of potatoes, should be spread over the surface of the field and ploughed in without loss of time. The moment the spring frosts are over, the planting should take place—in rows or in hills, (as described in the last

(1) Pythagoras forbade his disciples the use of beans—whence we may conclude, that the Greeks cultivated only the horse bean, or bean of the marshes.

article for corn;) and throughout the whole course of vegetation, the crop must be kept free from weeds, a condition, that if well observed, will secure an abundant produce.(1)

X. Of Oats.

Oats is, among grains, what the ass is among animals—very little respected, but very extensively employed. The *levis avena* of Ovid, and the *steriles dominantur avenæ* of Virgil, show the degrees, both of use and abuse, with which it was regarded by the Romans. In modern times, a great literary authority describes it, as food for Scotch *men* and English *horses*. It is probably this state of degradation among poets and philosophers, that determined the botanists of Europe, to give to America the honor of having produced it. Mr. Adanson found it growing spontaneously in Juan Fernandez; whence the scavans wisely concluded, that it must be a native of Chili! But in this conclusion, they appear to have equally forgotten the laws of nature and the decisions of history; for the quotations, with which we began this article, show, that oats were cultivated in Italy many centuries before the existence of America was known to any European; and few are ignorant, that Chili is among the hottest and driest regions of the globe, and that oats perish in dry and hot climates.

Of the many different species, or varieties of this grain, the *black* and the *white*, are those which best deserve cultivation; because most hardy and pro-

(1) In a favorable season, under good management, the white bean gives thirty for one.

ductive. In the poorest soil, and with the smallest possible labor, they give something, but because they do not give much, (in circumstances under which other grains would give nothing, we infer that the grain itself is a poor one, and at the same time a great exhauster of the soil. We owe to Mr. Dranus a series of experiments and calculations, which overturn this opinion, and demonstrate, that "oats, in rotation, under proper culture and in good soil, are not less profitable than wheat or rye; that after beans, cabbages or potatoes, it yields great crops, and that it exhausts less than other grains, which occupy the soil a greater length of time." As a protector of clover or other grass seeds, (and with it some of these should always be sown,) it is second only to barley.

XI. Of Cabbages.

These have been long known among us as a garden vegetable, but are rarely met with in field culture; a fact the more extraordinary, as, in England, they have been very extensively and profitably employed in that way for more than half a century.

The species most recommended, are the early Salsbury and York, the great Scotch, the Drumhead, the Cavalier and the green Savoy. Mr. Cobbett has remarked, with much good sense, that the species best for man, are also best for cattle, and that on this ground, the last of those mentioned should form the principal part of our cabbage crop.

The seed of early cabbages, (as the York and the Salsbury,) should be sown in hot beds, about the middle of February; and that of winter and fall cabbages, in the open field, about the 15th of May.

The bed selected for the latter, should be of good soil and well ventilated; that is, exposed on all sides to the influences of the air, and without artificial shelter. When the plants rise, they should be sprinkled with unleached ashes, or gypsum, and if attacked by the fly, may be slightly and temporarily covered with branches of elder. If the weather be uncommonly dry, a little watering may be proper, but much of this should be avoided, because plants, like animals, may become topers, and will then drink more than will be useful to them.

The transplanting of early cabbages should not be delayed beyond the 12th of May, nor that of the late kinds beyond the first of June. An acre of ground will require about six thousand plants.

The preparation of the soil, for this crop, is exactly that described for potatoes, and which, therefore, need not be repeated here. When the manuring, ploughing and harrowing are finished, strike your furrows, from east to west, four feet apart; place your plants in these, twenty inches from each other, and do not forget so to press the earth, as to bring it in contact with every part of the roots.

The advantage of this crop, will be best seen, by contrasting it with another; hay for example: If we get a ton of timothy, per acre, we think we do well and are satisfied; yet, if this acre had been well worked and manured and planted in cabbages, it would, according to Mr. Young, have given you more than *thirty* times the weight of the hay. Why not then prefer the cabbages to the hay? Our cattle, it may be said, will not like them so well. Hear what

the same author says on this head ; “ Young cattle “ go through the winter well on cabbages ; ewes and “ lambs thrive on them ; fattening oxen improve *faster* “ on *them*, than on any *other food*, and never fall off, “ as they sometimes do, on turnips ; and milch cows “ do better on cabbages, *six to one*, than on hay, &c.” But the difficulty of preserving them through the winter, may be great ? Not half as great as that of preserving potatoes ; for a frost, that will convert these into dirty water, will do cabbages no harm, and may even do them good. Mr. Cobbet preserved them through a Long-Island winter, and had them sound and fresh in the month of May, and by a method equally cheap and expeditious ; requiring only a plough, a few leaves, straw or brush, and some shovels full of earth : “ and here,” says he, “ *they were* “ *at all times ready* ; for to this land, I could have “ gone at any time, and have brought away (if the “ quantity had been large) a waggon load in ten minutes.”

XII. Of Buckwheat.

This excellent grain is a native of Asia, whence it was carried to Africa, and thence, by the Moors, to Europe. In France, it yet retains the name of *Sarrazin*.

The species of it in cultivation are two—the common and the Tartarean, (*Polygonum Tartaricum* of Linnæus.) This last species is highly extolled by professor Pallas and others. It ripens earlier, and produces more, than the common species ; but, on the other hand, it shells more easily and has in it an unpleasant degree of bitterness.

Cattle, hogs and poultry are particularly fond of this grain, and no food fattens them more promptly.

Being entirely destitute of *gluten*, (the animo vegetable part of wheat) it is not convertible into bread; but made into batter and baked into cakes, it forms a very tolerable substitute. Another great advantage of buckwheat is, that, with a small degree of labor, it thrives well in the poorest sand or gavel: and that in dry clays, as in those which are only moist, it gives a good crop, and never fails to leave them loose, friable and clean. To the clay-land farmer, this property is invaluable; and to make the most of it, he should remember, that this labor saving grain, ought to have more of attention and liberality, than is generally given to it; for if, under the hard treatment, and in the bye-places where it is now cultivated, it yields much and works these important effects on the soil, how greatly would its usefulness be increased, were it made to follow peas, beans, cabbages, or potatoes, in regular rotation, and on a large scale.

We have already spoken of it as a manure, and we take this occasion to quote, from a late editor of the Theatre D'Agriculture of O. Serres, the following passage: "We cannot too much recommend, after our old and constant practice, the employment of this precious plant, as a manure. It is certainly the most economical and convenient the farmer can employ. A small quantity of seed, costing very little, sows a large surface and gives a great crop. When in flower, first roll and then plough it in. Its shade while growing destroys all weeds, and itself when buried, is soon converted into terreau."

The experiments of M. Vaucquelin shew, that of *one hundred* parts of buckwheat, *fifty* are carbonate and sulphate of potash and carbonate of lime.

SECTION X.

Of other plants useful in a rotation of crops, and adapted to our climate.

These may be brought under three classes ; those which yield a coloring matter, those which yield oil, and those whose bark is convertible into clothing. Of the first, are madder, saffron and woad ; of the second, poppy, colzat and palma christi ; and of the third, flax and hemp.

I. Of Madder.

Madder is the *Erythros* of the Greeks, and the *Rubia* of the Latins ; so called from its imparting a red color to wool and leather. It is cultivated in the Levant, in France, in Flanders, and in England ; but no where more extensively or profitably than in Holland. The province of Zealand is principally occupied with it, and the little island of Schowen alone gives annually one thousand tons of the root.

The species generally cultivated are two—the *Azara* and *Izari* ; names by which they are called in the Levant, whence the seed is generally imported to Europe, and preferred to that raised in more northern latitudes.

The soil most proper for this plant is rich loam, and the manures fittest for it the sweepings of streets

and gutters and mud of ponds.(1) It is remarked in England, that it succeeds better after a grain than after a grass crop. The preparatory labor should be performed in the fall, leaving a single ploughing only for the spring; which, like those that preceded it, should be as deep as possible. The planting should follow without delay. In the Levant they form beds, alternately, of unequal elevation; one high, the other low; on the latter the madder is planted,(2) and in the autumn of the second year, the surface of the higher bed is scattered over that which is lower; and by a similar process the next year, the lower bed is raised six inches higher than the other. By this management, the earth retains sufficient humidity for the growing plants.

In transplanting madder, care must be taken to preserve the buttons, which attach themselves to the roots, and that the roots themselves be ten inches apart in the rows, and their crowns not more than two inches below the surface.

The greatest duration of the plant is six years, but three is the permitted term; as after that age the roots lose in color and soundness what they gain in bulk. At three years, a single root has been found to weigh between thirty and forty pounds; and the larger the root the less does it lose, in proportion, by depreciation.(3)

(1) Young's works.

(2) Madder requires more moisture, in its first stage, than might be furnished by rains and dews. Thence arose the method of raising the plants in a seed bed, where they might be watered at will, and afterwards transferred to the place where they were intended to grow.

(3) In large roots this loss is 6-7ths, in small ones 7-8ths.

When the roots are taken up, they are suspended under cover, for ten or twelve days, to dry. During this time, much of the water of vegetation is evaporated; the plant becomes soft, and is then subjected to the heat of an oven, from which bread has been taken. After a second baking it comes out dry and brittle; and, to disengage from it the earth, the small fibres and the outer skin of the root, it is lightly threshed with a flail, after which it is fit for grinding.

Of Woad.

This plant, till 1756, was much employed, and furnished the finest blue color, and, in the opinion of some dyers, is even now very profitably united with indigo; giving to the color imparted by it, more intensity as well as duration. The maturity of the *leaves* (the only useful part of the plant) is announced by their drooping and by the yellow color which they take. At this signal they must be stripped from their stems, housed, and left in mass till, freed from the water of vegetation, they begin to macerate by their own weight. They are then to be washed and reduced to a paste; after which a fermentation takes place, and the *secula* shows itself and forms a black crust, which is not to be broken, because necessary to prevent evaporation. When the fermentation has subsided, (which may be known by the diminished stench) the mass is pounded and formed into balls for use. The soil and preparation, indicated in the last article for madder, are most proper for woad.

Of Saffron.

This plant is cultivated only for the *stigmata* of

the flowers, which gave a yellow color, employed in dying and in *guache* painting. It succeeds best in a rich, friable black earth, or in one of a dark red or chocolate color. Some writers have remarked, that the roots, which are bulbous, grow to the greatest size in the former of these soils, and that the flowers attain the highest perfection in the latter. The manure best adapted to it is old and thoroughly rotted dung.

After being well ploughed, rolled and harrowed, the ground intended for this crop is trenched, and the roots placed in the trenches nine or ten inches apart. So soon as the flowers appear, (and they always precede the leaves,) the soil about them must be lightly hoed. When fully blown, and while wet with dew, they are taken off carefully with the hand and spread upon boards to dry. The stigmata are then separated from the styles, after which they are ready for market.

Of the Poppy.

The poppy is among the most important of the oil-giving plants—as well for the value as for the abundance of its produce. The oil is altogether found in the seeds, and does not partake of any somniferous or other deleterious quality, as some persons have supposed. It is often mixed with olive oil, and so long as it is fresh, it is equally pleasant and wholesome. It is much used in France, Holland, and Germany, in sallads. Its only fault is, that if long kept it becomes thick and viscous. The plant is annual, and requires a good and well-labored soil. The seeds should be taken from the ripest and larg

est capsules of the preceding year; should be sown early and thin, and in broad cast; because if thickly sown, the plants rot, and if sown late they are injured by a too rapid vegetation. The fall of the leaf, the dying of the stalk, and the brown color of the capsules, indicate the time for harvesting the crop. These last are carefully gathered and dried, and the seed separated from them.

Of Cole.

Cole is a variety of the cabbage, the seed of which yields an oil very useful to the arts, and renders the plant of great importance in agriculture. Its general management does not differ from that of any other variety of the kind. When the seed is ripe, it must be carefully gathered and separated from its chaff. The plantations of cole in Flanders, and particularly in the neighborhood of Lisle, Hasbrook and Douay, and on a part of the Escant, are immense. They generally follow a crop of well dunged, well labored potatoes, and are followed by one of wheat.

Palma Christi (the ricinus of botanists) has been cultivated in this state; but whether profitably or not we do not know. Its seed gives an oil fit for lamps, but principally employed as a medicine. The cultivation of this plant has been tried in the southern parts of France, but not on a large scale, as it was found to require much ground and to give few seeds, which ripen only in succession. In Carolina, the stem attains the height of ten or twelve feet, and a diameter of four or five inches. As an ornamental shrub, the palma christi is much to be recommended.

Of the Sunflower.

This plant is a native of Peru, and is cultivated, in Europe, principally for the seeds, which give a large proportion of oil, of much use for domestic purposes. It requires a good soil, well manured, and thoroughly worked and cleansed. The seeds should be sown one foot apart, and in rows two feet asunder. In France, the stems are employed for fuel and pea-sticks, and the leaves for fodder.(1)

Of Flax.

Flax is of Asiatic origin, and from its hardiness and usefulness, is generally diffused over the globe. No plant undergoes a greater change in the hands of labor, and few, if any, better repays the labor bestowed upon it.(2) It is cultivated with two different views—one, for the fibre which surrounds the stem, and which is convertible into cloth—the other, for the seeds, which yield an oil very important to the arts. These different objects have been supposed to be best promoted by different kinds of seed and different kinds of culture. In England, it is believed that the seed of this country gives a flax of greater length and of finer fibre ; and that the seed of Memel or Riga(3) produces a coarser plant and greater quantity of seed. We doubt, however, the correctness of this distinction, and think ourselves supported by experience as well as theory, in placing the difference less to the account of any peculiar quality of the seed, than to the greater or smaller quantity

(1) See Crete de Palenil on the sunflower.

(2) How wonderful the difference between the raw material and Brussel's lace!

(3) The flaxseed of Riga is broad and flat, and of a darker color than that of this country.

of it sown ; for we have invariably observed, that if flaxseed (wherever grown) be sown *thinly*, the stem is shorter, the fibre coarser, and the seed more abundant—and vice versa. This difference will necessarily be increased by different modes of culture. The row husbandry, admitting of more ventilation, will hasten more the maturity of the plant, and increase the quantity and quality of the seed ; whereas the broad cast method will, on the other hand, retard the maturity of the plant, lengthen the stem and the fibre that covers it, and in the same proportion diminish the quantity of seed.

Flax may be made to follow potatoes very advantageously ; and we have seen the practice of sowing it with a crop of that kind, earnestly recommended.(1)

The *time* for harvesting flax depends on the considerations suggested above. If *seed* be the principal end of the crop, your harvesting ought not to begin till *this* is completely ripe ; whereas if the fibre be your main object, pull the flax two or three weeks earlier. Flax thus prematurely pulled is called *white flax*, and makes the finest thread. The exhausting quality of this plant is generally admitted, and has been long known. Pliny says of it, that it burns and degrades the soil in return for the nourishment it receives from it.(2)

Of Hemp.

The cultivation of this plant need not be attempt-

(1) See 2d vol. Varla's husbandry.

(2) " Ut sentiamus nolente id fieri natura urit agrum deterioremq; etiam terram facit." Nat. Hist. L. xix.

ed on soils which are not naturally or artificially very rich. They who possess the former, will often find the culture of hemp useful in reducing the staple of the soil to that medium quality, which is best fitted for the production of *grain*. In some parts of our own country, hemp has been cultivated many years in succession, before this effect was produced; and in Italy, in the neighborhood of Bologna, (after centuries of cultivation,) the rotation continues to be *wheat* and *hemp* alternately, and without fallows. So also in the environs of Termonde, near Brussels, the usual rotation is *hemp, flax* and *wheat*.(1) It is, perhaps, to those favored soils we ought to look for the best mode of cultivating this very useful and profitable plant. "During the first year," says M. Simmonde, in his picture of Tuscan agriculture, "the field intended for hemp is laid flat by the small Tuscan plough, in the months of August and September. This is followed by the great plough, which reinstates the four feet furrows, and throws up the intermediate earth into ridges. The manure is applied to these in the spring; after which the hemp seed is sown and the ground harrowed. This crop, like that of flax, should be weeded when about four inches high."

Of Swallowwort or Dogsbane.

This is the *asclepias syriaca* of the botanists, and not improperly called the cotton of northern latitudes. Its cortical fibre yields a fine soft and white thread, and the pods a silky material, usefully employed in waddings and in hat making, &c. "There are few plants" says Sonnini, "the culture of which

(1) Francis de Neauchateau's state of husbandry in the senatoriat of Brussels.

unites more advantages, or which is more worthy the attention of farmers. In Silesia, it has made considerable progress, and experience shows that in a middling, or even a bad soil, it gives a product eight times more valuable than the finest crop of flax or hay. It requires a strong and moist soil, well labor-ed and manured, and may be propagated by seeds, by suckers, or by roots. The row husbandry is the most proper for it, and in the course of three years, the intervals between the furrows will be completely filled up by new and multiplied shoots.

Of the plant called *New-Zealand Flax*.

This is the formion tenax of botanists; the leaves of which, by maceration in water, yield a fibre remarkable for beauty and strength. We owe to M. Labillardiere, a series of experiments, the result of which shows, that the strength of flax being 11, that of hemp is 16 1-3, and that of formion 23 5-11. In the hot countries, (of which this plant is a native,) it is found on the sea-shore, growing sometimes in wet or marshy soils, and sometimes in arid sands. M. Thouin has succeeded in naturalising it, in the north of France, which gives reason to believe that it may be made to succeed in this climate.

SECTION XI.

Of Meadows.

These are either natural or artificial; the former, containing only plants of spontaneous growth; the latter, those selected, sown and cultivated by man.

The better to keep this distinction in view, we shall speak of them separately—and,

I, *Of Natural Meadows*

These have been classed by botanists according to their *elevation*; and have thence been denominated, high, middling and low. But as this principle fails altogether to indicate their agricultural character and properties,(1) a better one has been found in their relative moisture; whence they are denominated dry, or moist, or wet. The products of these have been carefully and skillfully analysed in Germany, in Italy, in England, and in France,(2) and the result shews, that wet meadows contain the smaller number of the different species of plants, but the greater number of those which are either useless or injurious; and, on the other hand, that *moist* meadows contain the greater number of the former, and the smaller number of the latter. The following simple table exhibits at a glance the present state of knowledge on this important part of our subject:

Whole number of Plants

in wet meadows,	30 ;	useful 4,	useless or bad 26
Do. in dry meadows,	38 ;	do. 8,	do 30
Do. in moist meadows,	42 ;	do. 17,	do 25

The agricultural labors suggested by these facts, are of two kinds—the eradicating of useless or pernicious plants, and the continuance and multiplication of those which are good. The first of these objects is promoted by mowing the meadows before the

(1) We often find bogs on the tops of mountains, and arid sands on the banks of rivers.

(2) See *Observations made by the Agricultural Society of Great Britain*, and *Mémoires sur l'Agriculture du Boulonnais*, &c. &c. per M. Dumont de Coursit.

seeds of noxious plants ripen, by pasturing them, once in three years, by sheep, horses and cattle, in succession; by harrowing them in the spring and fall; by weeding and hoeing them; and lastly, by sufficiently draining those that are wet.

Many pernicious plants are annuals, and are killed by the first of these operations. A similar effect is produced by the second; the harrow or scarificator, will best destroy mosses or other weeds, whose roots are fibrous and superficial; the hand-hoe will extirpate such tap-rooted plants as resist the harrow, and are refused by cattle, and draining will expel all worthless aquatics.

Of these remedies, the last may require some explanation. Meadows are wet from different causes; from obstructions [accidental or permanent] to the course of rivers; from occasional inundations; from high and uncommon tides; from neighboring springs issuing sometimes above and sometimes below the level of the grounds you wish to drain, and frequently from others rising up within the meadows themselves. In the first case, the remedy is obvious, and consists altogether in removing the obstructions; in the second and third, embankments, as in the Mississippi and Delaware, will exclude the flood; and in the fourth and fifth, the cure lies in creating a surface of lower level than that of the meadows to be drained, or, in raising the water to a level above that of the meadows, and carrying it off by race-ways or canals. The former of these methods is to be executed by ditching, or by digging through the sub-soil into sand or gravel, whence the water will find a sub-

terranean passage. The latter is effected by enclosing the springs within walls, and permitting them to rise to the level of their own source. It is evident, however, that if these be not higher than that of the meadow, the experiment will fail.(1)

The second object, (the multiplication and continuance of good plants,) will be insured by scattering in the fall, or spring, or both, (after the harrow or scarificator,) the seeds of useful grasses, 2) particularly upon places rendered raw or bare by the harrow or the hoe; by covering the meadows in the fall with straw, dung, lime, or marl; and in the spring, with plaster of Paris or ashes; by folding or parking sheep, or horned cattle, (during the summer and while the ground is hard,) on places requiring manure; by foddering on such places during the winter; and lastly, by *irrigation*. This last and most efficient method of bettering the condition of meadows, is sometimes characterised by the duration of its means, and sometimes by the mode of applying them. In the first case, it is called *temporary* or *permanent*, as the stream it employs may be the one or the other. In the second case, it is denominated *filtration* or *submersion*, according to the effect produced. If, for instance, the surface be only wetted by running water, it is called filtration; but if entirely covered with water, in a state of rest, it is called submersion. These different modes have some princi-

(1) See Anderson's Essays on Agriculture, vol. i, p. 119, &c.

(2) In selecting these grasses, care should be taken to employ those most resembling the spontaneous growth of the field, or, in other words, those which flower and seed at the same time with this spontaneous growth.

ples common to both, and some peculiar to each. The common principles are,

1st. Such command of water as will cover the largest surface with the least labor and expence.

2d. Muddy water, (the effect of loosened soil and heavy rains,) is most favorable to vegetation, because, besides giving the necessary moisture, it furnishes a considerable portion of alluvial matter.

3d. Water, charged with sand or gravel, or containing iron or vitriol, or of a temperature very hot or very cold, is unfavorable to vegetation, and ought not to be employed, until, by standing in reservoirs, it deposits these injurious matters in the one case, and in the other acquires the temperature of the atmosphere.

4th. Clay and calcarious soils require less watering than others.

5th. Irrigation is of less importance in northern than in southern latitudes; and,

6th. In cold climates, or in situations of much elevation, irrigation is most usefully employed in the spring and autumn; and in hot climates and sandy soils in the summer.

The principles peculiar to the two modes, may be collected from the following brief detail of the labors necessary to each. In irrigating by submersion, the first and great labor is to make a *dam* of such strength, as shall resist the volume of water by which it may be pressed—of such height as will raise the water above the level of the ground you wish to overflow, and of such structure as will enable you to discharge the water it collects promptly and entirely. The

signal for doing this, is the rising of air-bubbles from the bottom of the pond, which never takes place until a decomposition of the plants below begins. In winter, this tendency to decomposition is corrected by cold ; and the submersion may, of course, be continued for weeks, and months, and the water permitted to freeze, not only without injury, but with great benefit to the plants, particularly if they have been closely pastured in the fall.

Filtration is a process requiring, in general, more labor and science than the other ; because, besides a dam to raise a sufficient head of water, you must have your canal of derivation, your reservoir, your cuts or ditches, and lastly, your fosse of discharge—which, to be useful, must be well constructed and judiciously placed. The canal and reservoir will necessarily occupy the highest ground, and be proportioned to the quantity of water to be conducted and retained ; the cuts or ditches, supplied from the reservoir, will be parallel to each other, of nearly equal descent, but of diameters diminishing in proportion to their length, so as to give to the water the same swiftness it had when its volume was greatest. Stops or gates must be made in the cuts or ditches, in such number as may be necessary so to pond the water as to make it overflow the lower sides of the ditches, and at such points as will, from the shape of the ground, diffuse it most generally. In this way, small streams, occasional showers, and dissolving snows may be turned to great account, and with this additional advantage, that they require no reservoirs, and little if any draining, and only cuts or ditches formed with a plough or a hoe.

A third kind, compounded of the two others, is sometimes seen in Europe, where the water, after being employed in irrigating the sides of hills, is brought upon flats for the purpose of inundation, or more generally for that of forming reservoirs, from which it may again be raised by machinery, such as the *noria* of the Moors, or the hydraulic ram of Montgolfier, &c.(1)

II. *Of Artificial Meadows.*

We have seen that natural meadows abound in plants either useless or pernicious; and that it is among the principal labors of agriculture to eradicate these, and to substitute for them others of greater product or better quality. It was probably this process that first suggested the idea of *artificial meadows*, or those composed only of plants of our own choosing, and alternating with grain or root crops. And it cannot be doubted, but that if the grasses selected be good in themselves, adapted to the soil and carefully cultivated, we thus arrive at the highest possible degree of perfection, of which this branch of the art is susceptible; because, besides having only *wholesome* and *nutritive* forage, we *double its quantity*, and at the same time, put the soil in a state to give us a series of good subsequent crops.

France claims the credit of having been the first to discover the value, and introduce the practice, of this new system; and it may not be amiss to collect some

(1) Whoever may have occasion to study the two subjects, (draining and irrigation) either separately or in connexion, cannot do better than to consult the *Hydraulic Architecture* of Bellidor, the *Hydraulics* of Dubuat, M. de Ourche's *General Treatise on Meadows*, Defue on the embankments of Holland, and Richardson's *Agriculture*.

of the reports of her writers, on the agricultural changes wrought by it, "If," says Yvert, "meadows be the nerve of good husbandry, it is, above all, to artificial meadows we must apply this great truth. The state of those cantons, which have adopted the new system, is now as brilliant as it was before wretched and miserable. Alsace has put on a new face since the introduction of clover, and wheat crops have been increased more than one third. The village of Sebach, under the old system, bought annually 180,000 pounds of forage, and now sells 150,000. The canton of Virien, which gave formerly only rye and buckwheat, (and poor crops of these,) now gives abundant crops of fine wheat. This is altogether owing to clover and gypsum. The same remark applies to the department of Doubs. In the department of the Seine and Oise, the four year rotation is adopted, of which clover is the basis, and more than doubles the produce for exportation. In Varrenne, the soil of which is a poor sand, the same effect is produced by sanfoin, instead of clover. In a canton of the department of Loiret, M. Sageret has doubled his income, by the introduction and culture of lucern."

It would be mere waste of time to multiply quotations on this head. Few men of our own country, who have had their eyes open for some years past, but must have seen the wonderful effects produced by plastered clover; and if there be any who resist these evidences, or are insensible to them, they must be far beyond the reach of instruction. We hasten, therefore, to another and important part of our sub-

ject—the choice of grasses for artificial meadows. Those most recommended, by the experience of all countries, are lucern, sanfoin, and clover, of the leguminous family; and timothy, oat-grass, ray-grass, and meadow foxtail, of the gramineal. We shall say a few words of each. And 1st. of *Lucern*. This plant is a native of Media, whence its Latin name *Medica*. It was well known and highly esteemed by the ancients, uniting in itself many valuable qualities—early fitness for use, great productiveness, and duration,(1) and juices, the most nutritious and acceptable to cattle. In the south of Europe, it still maintains this high reputation, and in our southern climates would entirely deserve it; but of its success *here*, we have doubts, founded on the fact, that all attempts made to introduce it, and coming within our own observation, have failed. Two conditions are, however, indispensable to its prosperity in any climate; and these are, a *rich soil* and *careful cultivation*. In wet, or stony, or stiff ground, it does not thrive. Its long tap-root must plunge into the earth, without obstruction, otherwise the plant suffers and dies prematurely. 2d. *Sanfoin*. This grows well in Europe, as high as the 51st degree of north latitude. A species of it is found growing spontaneously in the Pays de Calais, which shows itself earlier than the more common or Spanish species. Its produce is less than that of lucern; but the quality of its herbage, whether green or dry, is better. Sheep are particularly fond of it. It affects high, dry, naked,

(1) "Tante dos est ejus ut cum uno setu tricenis annis duret medica." Plin Nat. Hist.

white, cretaceous soils; ameliorates the condition of these, and holds them better together than any other plant. The following extract may give both instruction and encouragement to those who would cultivate this plant: "In Calabria, the sanfoin is sown upon wheat or other stubble, which is then burnt, and the ashes made to furnish a covering for the grass seed. In the spring, without other care or culture, the field is found covered thickly with sanfoin, and converted into a fine meadow. 'This grass crop is cut and fed between May and August; when the ground is ploughed for grain, the crop of which is generally very abundant. But the advantages of this husbandry do not end here; for after the grain is harvested, the earth resumes its covering of sanfoin, which, in this way, is continued forty years and more, admitting every second year a crop of fine wheat.'"(1) 3d. Like sanfoin and lucern, *Clover* is of the leguminous family, and though less productive than the other, has one advantage that gives it a decided preference; viz. its growing well in a great variety of soils. In gravel, in loam, in alluvial and calcarious earths, it does well, and we have already seen that *in poor and sandy soils it doubles the income* of those who employ it—as well by increasing the quantity of forage, as by putting the ground into a state to yield many and abundant future crops of grain. Still there are soils (stiff, cold and wet) in which it does not succeed, and ought to give place to the gramineal family. 4th. *Timothy*. This grass, in Europe, is called herd-grass, cats-tail, or phleum

(1) Grimaldi on the agriculture of Calabria.

pratense, (the botanical name ;) but as the plant is of Yankee origin, we have chosen to retain the Yankee denomination. Its reputation abroad was at one time very high, and in moist grounds deserves to be so at all times ; but being very tardy in showing itself in the spring, it has, in many places, fallen into disuse.

5th. *Ray* or *Rye-grass*, (to the good properties of timothy) superadds that precocity which timothy wants. "We have seen," says Gilbert, "in the canton of Basle, rye-grass five feet high on the first day of June;" and M. De Courset assures us, that he has obtained "three cuttings from it in one year." Sheep are found to prefer it, in the spring, to any other plant; and the shepherds of Spain have a proverb, which very energetically expresses its nutritive qualities: "*Bouccado van ventrado*"—a mouthful is a bellyful. We particularly invite the attention of farmers having clay, or other moist or wet soils, to the cultivation of this and the two following species of grasses.

6th. *Oat-grass*, the *Avena elatior* of botanists, was first cultivated in 1754, and having been committed to a good soil, the results were highly favorable. It was accordingly recommended as yielding abundance of forage, and of a good quality; and that the first cutting might take place as early as the last of March. Though new and extended experiments have, in some degree, diminished this reputation, still enough of it is left to render this grass a favorite with every scientific agriculturist.

7th. Of the *Mendon Fox-tail* there are four species; but we shall speak only of the *Alopecurus pratensis*, which of all the grasses we have mentioned is the tallest,

the most vigorous, and the soonest fit for pasturage or the scythe. Its hay appears to be of a better quality than that of any other of the gramineal grasses, because *equally* relished by cows, horses and sheep. It is only, however, in soils neither too moist nor too dry, that it attains the perfection of which it is susceptible.

What remains of this subject may be referred to the general principles of tillage, and the particular preparation necessary for clover crops, both of which may be found in the preceding sections.

SECTION XII.

Of Orchards.

These are generally composed of Apple, Pear, Peach and Cherry trees. The *Apple* has been known from the most remote antiquity, and from the names given to it, would appear to have been a native of many different countries. (1)

About the close of the 15th century, the varieties of this fruit, in Europe, were multiplied to the number of forty-six, (2) and it is not to be doubted, but that four additional centuries have much increased this amount. While, however, the line was lengthening in this direction, it was shortening in another; for according to the philosophy of the present day, vege-

(1) The Syrian, Scanian, Pelusian, &c. About one hundred years before Christ, the Romans began to call them after particular men who had been instrumental in removing them—as the Appian, or Pomme D'Appian of the French, after Claudius Appian.

(2) See Olivier de Serres.

tables, like animals, perish not only individually, but by whole races.(1)

The uses of the apple are various. Besides those of the table, it yields the well known liquor called cider; which is again convertible into brandy. We have, in our country, orchards which annually produce from five to eight hundred dollars. In the view of profit, therefore, fruit is an important object to the agriculturist.

The *Pear*, is less difficult with regard to soil, than the apple tree. We have seen it grow well in light sand; and a part of Normandy, called Bocage, (the soil of which is a stiff clay) is renowned for its pears and for a liquor called *Perry*, made from their juices.(2)

Oliver de Serres counted *sixty-two* varieties of the pear, and according to the treatise of M. Van Mons, published in 1808, the number then cultivated in Europe, amounted to more than *six hundred*. Of these, we shall name a few, in the order in which they ripen. The Muscat L'Allemand, in May; the St. John and the Bergamot of Holland, in June; the Petit Muscat and the Cuisse Madame, in July; the Salviat and the Bon Chretien d'Ete Musque, in August; the Beurre Gris, in September; the Bergamot Suisse and Messire Jean, in October; the Bon Chretien Ture and the fall Bergamot, in November; the Chasserais, the Beurre D'hiver, the Merveille D'hi-

(1) See Davy's Elements.

(2) When made without the addition of water, Perry is an excellent liquor, and keeps well in bottles.

ver, the Vergouleuse, the St. Germain and the Sar-russin, in December.(1)

The *Cherry tree*, is said to have been first brought to Europe by Lucullus, from Asia Minor. A German amateur (the Baron de Truckless) has brought together, in his garden in Franconia, *sixty-five* species of it. Besides the raw fruit, the cherry is much employed in confitures, and gives also three liquors in much request—the Kirschenwasser of Germany, the Marrasquin of Venice, and a distilled but unfermented liquor of the Rhine, having nothing in it spirituous, and retaining only the watery and aromatic parts of the fruit. The cherry tree dreads cold or wet soils, nor does it succeed well in those which are either hot or dry. Its outer skin differs, in its organization, from that of other trees; the fibres are longer and stronger, and sometimes so bind the woody part as to obstruct its growth. Hence the practice of making shallow and longitudinal cuts through the outer bark; a practice, however, which, like pruning, ought to be skilfully performed, otherwise the wound becomes gummy, chanerous an incurable.

The *Peach tree* is a native of Persia, where it grows without cultivation. Its varieties are very numerous; all of which are much influenced by climate and soil. In Europe, it is only in the south of France, in Italy and in Spain, where you find peaches that have reached the perfection of which

(1) We offer this list as a direction to those who may wish to obtain the best succession of crops, and have, therefore, retained the names under which they are known abroad.

this fruit is susceptible; and in similar climates here we may, no doubt, have fruit equally good. Our own climate (that of New-York) does not appear to be favorable to its production. Our trees are often sickly and our peaches generally sour and watery, and entirely destitute of that aroma, which forms the great excellence of this fruit. After these general remarks, we proceed to what is more particularly the object of this section.

It has been said, and we think with much good sense, that "every farmer ought to raise his own trees," because, besides the risk, inconvenience and expense of bringing our plants from abroad, we have, in pursuing that mode of supply, to encounter the tricks and blunders of nurserymen and the ill consequences which follow a want of analogy between the soil in which the plants were raised and that to which they are to be transferred. The first step, therefore, towards obtaining a good orchard, is to create a good *nursery*. The situation most favorable for this, is a piece of level ground, defended from cold and violent winds, either by natural or artificial means, and which in composition is neither wet nor dry, and of only middling fertility. This condition of the soil is a circumstance of much importance, and ought to be rigorously observed, because the vessels of young trees, growing in rich soils, take a size proportioned to the quantity of sap they receive and circulate, and if their situation be changed for the worse, the quantity of the sap being necessarily diminished, the vessels become rigid and unhealthy, and unable to carry to the extremity of the branches the nourishment

required by them. The ground (selected on these principles) must be securely fenced, thoroughly ploughed and harrowed, freed from stones and the roots of perennial plants, and then thrown up into three or four feet ridges, on which you will sow and cover your apple and pear seed and plant your cherry and peach stones. It will now be useful to roll the beds for the purpose of bringing the soil and the seeds every where into contact; after which they may be covered with clean straw for the winter. In the spring your young apple and pear trees will show themselves, and after them your cherries and peaches. The treatment to all will be the same: they must be thinned to the distance of fifteen or twenty inches from each other, kept perfectly free from weeds, and, if the weather be hot and dry, occasionally watered. They require only a repetition of this process, with the addition of a little careful pruning, till they have attained the height of seven or eight feet, when they are fit for grafting. It is generally known, that by this operation we continue any given species of fruit—but a fact with which the public is less acquainted is, that if the graft be also grafted, the product is improved both in quantity and quality; and it is to be presumed, will continue to improve under every new and similar operation. Grafts, to be well chosen, should be taken from wood of the present year, from young and healthy races and accommodated to the future use of the fruit. If, for instance, your object be cider-making, you will take your grafts from the Crab or the Redstreak; and if for barrel-ling, from the Pippin, the Spitzenberg, the Greening

or the Swaur. As we but speak of grafting incidentally, it will not be expected that we should go into a dissertation upon that art, nor to elucidate the many divisions and subdivisions, which technical men have made of it.(1) It is enough for us to say, that of all these different modes, the *scion* and the *slit* is the simplest and the best. When your grafts have acquired some inches in length, it may be well to rub off *all* the buds which have pushed *below* them on the stem, and perhaps a *few* of those which have appeared *above* them,(2) and if the grafts themselves put out any lateral shoots, spare them till the succeeding year, when you are called to re-graft such as have failed, and to furnish props to those which are feeble, or crooked, or ill-directed.

Planting is the next operation in the process; but as some preliminary measures, on which its success will much depend, are yet unnoticed, we will begin with these; and,

1st. Of the soil chosen for your intended orchard. It is generally admitted, that fruit-trees do well in a warm, friable, moist and deep soil; that they succeed but indifferently in one that is cold and stiff, and that they altogether fail in one either very dry or very wet; but a fact less known, though not less established is, that the sub-soil has a powerful influ-

(1) The two grand divisions are by *approach* and by *scion*. Their varieties and sub-varieties, nearly a hundred, are known by the names of ancients and moderns—as Varro, Virgil, Columella, Malherbes, Duhamel, Bosc. Michaux, &c. &c.

(2) Many grafts are annually lost, by removing the upper buds, shoots and limbs. It throws too much nourishment into the graft, which dies of repletion. Having omitted in the text to say any thing of the different *stems* employed in grafting, we here remark, what all amateurs in fruit-trees ought to know, that scions, whether of apple or pear trees, grafted on *quince* stocks, give fairer fruit and much sooner, than if grafted on apple or pear stocks—but the trees are short lived,

ence on the health and prosperity of plants. If this be rock, or what is called hard pan, (whatever be the surface,) the tree and its fruits are much deteriorated—nor will the remedy, sometimes resorted to, of cutting off the pivot or plunging-root, and leaving the tree to subsist by those which are merely lateral, be sufficient. It may palliate, but it does not cure.

2d. Next to soil, *exposition* is most important. In this climate, northern and western expositions are bad, because the tree has least time for vegetation—because its juices are less concocted, and because it is itself most exposed to the action of high winds. These remarks will sufficiently indicate why eastern and southern expositions are favorable, and ought to be preferred. But the rule these facts suggest cannot be made absolute, since many persons occupy only the northern and western sides of hills. In these situations, therefore, the course most approved by theory and experience is, to plant only trees which are late in forming or maturing their fruit.

3d. The preparation of the soil is not to be neglected, and any summer crop in rows and well cultivated forms a good one. With these remarks we return to our general head of *planting*.

The *form* in which your trees stand, is not matter of indifference. The *Quincunx* is recommended, as giving to them that position which is relatively best; but the *Caize* (straight lines intersecting each other) better admitting the movements of the plough, is generally preferred. Whichever of the two be adopted, the holes indicated in a former part of this section, must be made accordingly, and ought to be six

feet wide and as many long and two feet deep. The advantages of these will abundantly repay the extra labor they require, as we find by M. Chalumeau's experiments on peach trees, from which we make the following extract: "Four peach trees resembling each other, as to size and vigor of growth, as much as possible, were planted. No. 1, in a hole three feet square: No. 2, in a hole two feet square, and Nos. 3 and 4, in wholes eighteen inches square. The soil and exposition similar. No. 1 has every year given the most abundant crops, and the relative sizes of the trees now are as follows: the stem of No. 1, 18 feet high and eight inches in circumference; that of No. 2, 9 feet high and 5 1-2 inches in circumference; No. 3, 6 feet high and 3 inches 2 lines in circumference, and No. 4, 5 1-2 feet high and 3 inches in circumference." Here is a difference between the largest and smallest of 5 inches in circumference and 12 1-2 feet in height—a most decisive proof of the advantages of trenching.(1)

When the holes are thus provided, and at a distance not less than 30 feet from each other, and a portion of the soil (mixed with marle, the mud of ponds or bog-earth) returned to them, you may then begin to take up your young trees from the nursery, and in doing this you must be careful not to wound or otherwise injure their roots, or their bark; nor must they suffer any topping or pruning. Three hands are necessary to planting; one to place and align

(1) The apple, the pear, and the cherry, occupying more room than the peach, require proportionate trenches.

the trees, and the others to fill in the remaining part of the earth, mixed as above mentioned. It now only remains to fix short poles (technically called tutors) near them, to which they may be tied, and by means of which their true vertical position may be preserved.

The year after planting, and in the month of February, when there is no circulation of sap, you will do well to begin to give to the heads of your young trees that form which you wish them ultimately to take. The more circular you make them the better, always taking care to lop off those branches which do already, or may hereafter, cross others having a proper direction. This proper direction will be generally horizontal, but with a slight curve; an opinion requiring, perhaps, a little explanation. All strait branches produce what are usually termed gourmands, (or gluttons,) giving little if any fruit themselves, and exceedingly exhausting the tree. Curved branches, on the other hand, rarely produce gourmands; and when the season is favorable, give much fruit. The observation of these facts, made long since, and probably growing out of the management of espaliers, first suggested the practice of bending strait branches by artificial means. The effect entirely justified the theory: these strait and barren branches, bent into nearly half a circle,(1) changed their character with their shape, and became very productive. But there is a time for this, as for all other things, and unless the experiment be began

(1) More than half a circle will obstruct the circulation of sap and destroy the tree.

about the first of July, and continued to September, it will fail ; because it is only within that period that fruit buds are formed.(1)

As your trees advance in age, they will require *pruning*. Suckers must be removed, and dead and dying limbs taken off. For this purpose a hand-saw, a chissel, a mallet and a gardener's knife are the instruments to be used : all others must be proscribed, and particularly the axe, which, in the hands of folly and ignorance, has been so mischievous to fruit trees. Wounds, if large, should always be covered from drying winds, from moisture, and even from air. In gummy trees, as the peach or the cherry, this precaution is indispensable, and the neglect of it a disgrace, since the best covering is that composed of cow dung and clay—materials costing nothing and always at hand.

On this subject we have but one other rule to give, and that is, to open the ground about the roots of your trees in the fall, to the influences of the air, rain and frost. The last of these, besides promoting vegetation, destroys many insects in the chrysalis state, which, if left undisturbed, would in the spring be very injurious. Another part of the same rule is, to cover with straw, in the spring, the ground you make bare in the fall ; the object of which is to prevent evaporation by intercepting the rays of the sun, and thus securing to the roots the moisture necessary to their welfare.

(1) The circulation of the sap is then slowest. See Art. Courbure, Nouveau Cours d'Agriculture, Vol. iv.

SECTION XIII.

Of Farm Cattle.

These consist of horses, mules, cows, oxen, sheep and hogs. It is not the object of this paper to discuss the relative value of animals of different kinds, nor to explain the principles on which an individual of either kind, is preferred to another individual of the same kind, but merely to indicate the uses of each, and the modes most approved for giving extension and value to these uses. And 1st of the Horse :

Of this animal, naturalists admit but one species, but many and widely different varieties, which are again subdivided under the denomination of races.(1) At the head of these, by common consent, stands the horse of Arabia, and after him, the Persian, the Barb, the Andalusian and the English. His flesh not entering, like that of the ox, into the general and ordinary subsistence of man,(2) he is valued only for the beauty of his form, the nobleness of his carriage, the rapidity of his march, and the strength, spirit and patience with which he bears the heaviest burthens and the most excessive fatigues. •

Of these powers, some curious and extraordinary instances are recorded. The couriers of Russia travel from Petersburgh to Tobolsk, a distance of

(1) Bakewell and others have shewn, that you may multiply these races at will. By selecting two individuals, of any given shape, size and color, which you may prefer, you secure a progeny, having all the qualities of their parents. This observation applies as well to horned cattle and hogs, as to horses, and might be usefully taken as a rule of conduct in this country.

(2) Horse flesh is eaten by the Negroes of Africa, the Arabs, Tartars and occasionally by the Chinese. Page 213, vol. 22d Buffon's Nat. His.

19° 26 m. in twelve days. Their rate of travelling is, of course, about one hundred miles a day. What, in equestrian phrase, is called a great mover, will, without pressing, trot 640 yards in 80 seconds, and if pressed will go over the same distance in 50 seconds. In the first case, the rate of moving is 5 feet 3 inches per second, and in the other, 8 feet 5 inches. The Roman horses, probably descendants from Barbs, run at the rate of 27 feet the second of time, and the British horse Childers, is said to have run at the rate of 45 feet 5 inches, and Sterling, another British horse, at the rate of $82\frac{1}{2}$ per second.(1) This may be regarded as the maximum of horse speed.

The ordinary load, in France, of a four wheeled waggon, drawn by six horses on a pavement, is 10,000 pounds. That of a cart, drawn by four horses, 5,500. With these loads, they travel 10 leagues a day for six weeks together. A single horse has been known to draw 500 pounds at the rate of 140 yards in 112 seconds, and on the pavements of London, a single horse has drawn 6000 pounds for a short distance, and 3000 for a considerable distance and with facility. This appears to be the maximum of horse power in drawing.

Under the pack or saddle, 300 pounds is the ordinary load for a horse, but according to M. Thiroux, a dragoon horse carries 340 pounds. This includes

(1) British Zoology for 1763-4. In Peru, are two races of horses, (originally Andalusian) well worth the attention of the rich amateurs of the United States. The names by which these races are known, are the *Parameros* and the *Aqualillas*. See Ulloa's voyage, tome I. page 370. In Chili also, is a race, which, for beauty, action and hardiness, may be compared with the horse of Arabia, and with this advantage, that they are very cheap, while those of Arabia, are very dear. See Molina's Nat. Hist. of Chili, pages 595 et seq.

the weight of the rider and of his arms, accoutrements and baggage. The well known experiment of Marshal Saxe, shows the maximum of horse power, in this respect. He directed, that a strong and vigorous horse, while in motion, should be loaded untill he fell. The effect was not produced, until the load amounted to 1,200 weight. (1)

II. *Of the Mule.*

This is the well known product of a jack and a mare, or of a horse and a jenny, the name given to a female ass. Their advantages over the horse are, that they are more patient of hunger and heat; are less nice or delicate with regard to their food; sustain better and for a longer time, fatigues of all kinds; carry heavier burthens; are more sure footed; less liable to sickness and live to a much greater age. In Italy and Spain, they are much employed in harness, and in the mountainous parts of those countries, for the saddle. Their value and qualities, however, depend principally on those of the size: if he is large, active and strong, his progeny will be proportionably valuable. Nothing therefore can be more ill-judged than employing small jacks. (2)

III. *Of the Con and the Ox.*

It was long supposed, that this animal was a native of Europe, and that the Auroch, found wild in the forests of Poland, was the type of the species. The researches, into comparative anatomy, of Cuvier,

(1) See Fourcroy (of the corps of Enginners) on the powers of the horse, quoted by the *Nouveau Cours d'Agriculture*.

(2) The Asses of Arabia, Egypt and the Barbary coast are the best. In Sicily is a race of inferior size, but of great powers. See Sonini's Supplement to Buffon on this animal.

have overthrown this creed, and men of science now substitute for it another, viz: that the cow is a native of Asia, and has thence been translated to other parts of the globe. Be this fact as it may, her uses are so many, so various and so important, that we cannot hesitate to transfer from the horse, the distinction bestowed upon him, by an eloquent writer of the last century, and to pronounce her, "*the noblest conquest made by man.*"(1) During two thirds of her life, (which may be protracted to twelve years) she is annually producing her species, and during the same period, yielding an abundant supply of that beverage, so universally known and so generally acceptable, so happily adapted from its compound nature (part animal and part vegetable) to all ages and conditions of man; to the young and to the old; to the poor and to the rich; to the sick and to the sound, and which, in its concrete forms of butter and cheese, has, in all civilized countries, become an article of first necessity. Nor is her value diminished by death; for having been fatted and prepared for market, her flesh forms our most savoury and substantial food; her tallow in the form of candles, supplies the absence of natural light; her skin, wrought into leather, furnishes shoes and other articles, rendered necessary by habit or custom; her horns, are converted into combs and lanterns; her blood, is essential to the refinement of our sugars; chemistry draws from her hoofs important uses; and her hair is made to pad our collars and saddles, and, by entering into the construction of our buildings, adds to their beauty,

(1) Buffon's Nat. Hist. Vol. 22.

comfort and solidity. If in her progeny, (the ox) strength and speed be less combined than in the horse, it will be also remembered, that his subsistence is cheaper, and his labor more continued and persevering; that he is besides, less liable to accidents which diminish his value, and that he may even become lame and blind, without eventual loss to his owner: for, when prepared for the shambles, like his parent, he gives us beef, tallow, &c. and those of a superior kind. How important then is it, that this useful animal should be multiplied, and that pains should be taken to ameliorate the breed. In England and in Holland, wealth, enterprize and philosophy have combined, to exalt the character of domestic animals, and the effect has been to create many new, artificial and more perfect races. These are examples we ought to follow, and these are the countries which can best enable us to do so.

It has, however, been found, that in temperatures, either very hot or very cold, the bulk of the cow is diminished, and though it is by no means verified, that animals secrete milk in proportion to their size, still, on other accounts, the largest cows may justly be considered the best. Treatment, or the quantity and quality of food, has a still more decided influence than climate, on animal growth and developement, and hence it is, that when the cows of England, Holland or Switzerland are transfered to pastures less abundant or nutritive than those in which they have been reared, or are otherwise put on shorter allowance than that to which they have been accustomed, their qualities degenerate, and their progeny with them.

The lesson that these facts inculcate, cannot, we believe, be mistaken, and will not, we hope, be overlooked.

IV. *Of Sheep.*

Of the different races of sheep, we shall speak only of two, those of Spain and England; because, in them, are best united the two great objects for which this animal is reared—*wool* and *food*.

The sheep of Spain, generally known under the name of Merinos, are composed of two classes, the *travelling* and the *stationary*. The former of these, is again divided into two distinct races, called the *Leonese* and the *Sorian*; while the latter, composed of a number of degenerate breeds, are denominated Charras. The Leonese and the Sorian winter in Estramadura, and are never parked or housed, excepting for fifteen days of each year, at the Esquileos, or shearing houses, near Segovia. After this operation, their march to the mountains begins in two columns; the one, to old Castile and the kingdom of Leon; the other, to the province of Soria, and, subsequently, to Navarre or the Pyrennees. The preference of the Leonese to the Sorian, is sufficiently established by the fact, that the wool of the former sells for one fourth, and sometimes for one third more than that of the latter. But even in this pre-eminent race, there is a marked difference between the different troops composing it; those of the late Prince of Peace, of Nigretta, of Montaco, of Peralez, of Fernando Nunez and of l'Infantado, are particularly distinguished by the fineness, and what, in technical language, is called the *nerve* of their wool.

The policy of Great Britain was early directed to

the amelioration of sheep. It is, however, to Henry VIIIth and to Elizabeth that the praise is particularly due, of importing into England, sheep of the finest Spanish races; of promulgating rules and regulations for their proper management, and lastly, of commencing that prohibitory system, which has secured their continuance, and what is of still greater importance, the *exclusive* fabrication of the wool they produce. It was not, however, in the power of laws, entirely to abrogate, or even materially to alter, the effect of climate. That of England did not so much favor the production of *fine* as of *long* wool, and hence it is, that the wool of that country is not so remarkable for the former, as for the latter of these qualities. But in all cases, when our object is to unite the two great products of *wool* and *flesh*, it is to their breeds we should look for the best means of doing it. The flesh of the pure Merino is neither so abundant, nor so well flavored as that of the mixed races, and when brought to the greatest perfection, the quantity of his wool is less. His carcass, when prepared for market, does not exceed 10 pounds a quarter, and the average weight of his fleece will not rise above 4 pounds; whereas the best English races give 25 pounds the quarter, and fleeces weighing 7 and 8 pounds each.

V. Of the Hog.

The wild boar is considered the type of this species, of which there are several varieties. The most distinguished of these are, the Asiatic or Chinese hog, the European hog, with long, broad and pendant ears, and the Solipede, or horse-hoofed hog of Swe-

den.(1) As this animal is principally useful as food, the improvers of the species have aimed only at forming a race which, with the least expence and in the shortest time, should acquire the greatest bulk and the highest degree of fatness. It is on this principle that the Chinese hog, which fats promptly and easily, but which attains only to a small size, is with great propriety mixed with the hog of Europe, which acquires a much greater bulk, but is proportionably slow and difficult of fatning. The result of this mixture has been many improved races, at the head of which stands the hog of Parana, and those known in England by the names of the *Bakewell* and *Byfield* breeds.

The weight of the hog, at eighteen months or two years of age, (taking for granted a regular and sufficient nourishment,) varies from two to four hundred pounds. Buffon mentions a hog killed in England, which weighed 850 pounds. Sonnini, his commentator, mentions another, killed in France, which weighed 990 pounds; and Mr. Jefferson a third, killed in Virginia, which reached the enormous weight of 1200 pounds.(2)

The value of the hog is increased by their natural fecundity, which much exceeds that of any other species of domestic animal. This subject was thought worthy the pen of Marshal Vauban, who left behind him a manuscript calculation of the offspring of a single sow. The paper was read in the Institute of

(1) This is the *Sus angula indivisa* of Linneus. Aristotle was the first to mention this species and after him Pliny. Linneus says, it is common in Upsal and other cantons of Sweden. *Amenitat. Acad.* tome 5 page 459.

(2) Notes on Virginia.

France some years ago, was heard with great interest, and gave an enormous result, but not sufficiently recollected to be stated here.

As, from the constitution of the human mind, there have been sceptics on all subjects, little and great, so on this we find some doubting whether the hog did not, from his insatiable appetite, consume more, during his life, than the amount of his value at the time of his death. These doubts could not fail to engage calculating men, in ascertaining this point. Their experiments show a profit of eight dollars on every hog, reared and fed to the age of two years, by persons having no farms and obliged to buy every article going to their nourishment. How much greater, then, the profits of those who have the means of subsisting them on grasses and roots, which cost only the labor of raising?

To these specific remarks upon different animals, we now proceed to add a few observations on the breeding of cattle, and a brief view of the general principles on which the fattening of such of them as enter into the subsistence of man, more peculiarly depends. And,

1st. Of the breeding of cattle.

It rarely happens that the breeders of cattle are the fanners of them. The first of these employments seems more particularly to belong to those who, (other circumstances being favorable,) are remote from markets; the second, to those who, from local situation or navigable streams, are convenient to markets. In the breeding business, two conditions are indispensable to its success. 1st. That the sires

of each species be well chosen ; because their qualities and appearance have much more influence on the character of the offspring than those of the females ; and 2d. that, during pregnancy, the females be abundantly fed, and otherwise subjected to no hard or injurious treatment.(1)

2d. Of the fattening of cattle.

The objects in fattening cattle are two—the increase of tallow, which is an important article in domestic economy ; and the improvement of the fleshy or muscular parts ; it being found that the lean meat of fat animals was better flavored and more nutritive than that of poor ones. The means of effecting this object are, either living vegetables, or those which have been cut, dried and stored for use. Under the first head are the whole family of the grasses, and under the second, grains, roots, peas and beans. When we resort to the first, the only care necessary is, that the provision of plants be both abundant and nutritive. Upland pastures, where they unite these conditions, best fulfil this intention ; but the fat of cattle thus fed, though better distributed, (the effect, as we believe, of exercise,) is less in quantity and of an inferior quality. The second mode, which is called *stall feeding*, is more difficult and expensive, and requires great attention to the repose of the animal, to his cleanliness, and to the caprices of his appetite. In England, where this business is most practiced and best understood, they envelope the head of the fattening animal in several folds of woollen cloth, so as

(1) The inhabitants of the Boulonais, in France, employ the mare instead of the horse, for all agricultural purposes ; because, besides laboring the soil, they give yearly a foal, which they sell at eight months to the graziers of Normandy.

to deprive him, in a great degree, of the power of hearing, and altogether of that of seeing. The doors of his stable are opened but once a day, to change his litter, and his food and drink are given through loop holes opening into his manger, which are afterwards immediately closed. With respect to feeding, the first rule is, to give little at a time and often; because experience has shown, that animals that eat much in a short time do not fatten so well as those which eat less, but more slowly and frequently. The second rule is, to begin the course with cabbages and turnips; then to employ carrots and potatoes, and lastly, Indian, oat, or barley meal, the marsh bean or the grey pea. These aliments ought to be varied five or six times a day, and oftener if convenient; and instead of always reducing them into flour, there is an advantage in sometimes boiling them. A little salt, given daily, is very useful, and for drink clean water, but neither frequently nor in great quantity. Warm water, by its temperature, most favors digestion, but if long continued, will enfeeble the stomach.

It ought, therefore, to be employed only towards the end of the term. The fatning is complete, when the superficial inequalities of the animal, whether muscular or bony, are filled up; when his body presents only a round and smooth surface; when he becomes drowzy and inert, dislikes motion and apparently insensible to every thing about him. These are the signals for death, and the sooner you inflict it after their appearance the better; for should the feeding be farther urged, you run the risk of inducing the disease called the *melling of the grease*, or, in

more scientific language, the re-absorption of it, by the blood, which is always fatal.

They who are at all acquainted with the subject, on which we write, need hardly be told, that there are many circumstances, independent of food, cleanliness and quiet, which influence the fattening of cattle. We shall mention them separately, and add a few words to each, in explanation.

1st. *Constitution.* If this be not sound and healthy, no care nor expence will be sufficient to correct it. The animal will want appetite, or have too much of it, and what it eats will not better its condition.

2d. *Castration.* The flesh of males is hard, fibrous and ill-flavored; and that of females, not spayed, far inferior to the flesh of those which have undergone that operation. Where the testicles in the one, and the ovaria in the other, are early and completely removed, the animals become more docile, less restless, and fat with great facility.

3d. *Temperature.* Whoever makes the experiment will find, that this consideration is very important. The cold of winter, the heat of summer, and the capricious character of the spring, are all adverse to the fattening of cattle, though perhaps not equally so. The autumn, on the other hand, long and temperate, is the true season for that business, not only from the greater abundance of food which is then to be found, but because the transpiration of the animal is then first checked, and immediately converted into tallow. And

4th. *Age.* Tallow is formed from the surplus

nourishment given to animals, beyond that necessary to their mere physical developement ; whence it follows, that those which have not attained their full growth are fatted with difficulty, and only by extraordinary means. Calves, for example, can only be fatted by great quantities of milk, to which must often be added, eggs, barley or oat meal, or the flour of beans and peas ; and with all this abundance and selection of food, they yield little if any interior fat or tallow. Whereas oxen, at six years of age, with correspondent treatment, give large quantities of that article. Old cattle are also, from loss of teeth, debility of stomach, or other internal disorganization, difficult to fat. These facts sufficiently indicate what, on this head, ought to be our practice ; to *fatten cattle as soon after they have attained their growth as possible.* Oxen generally attain their growth at five or six years, and sheep and hogs at two.

SECTION XIV.

Of the Dairy.

THE business of the dairy, besides its connexion with the subject of the last chapter, is too important in itself to be omitted in any professed treatise on Agriculture. We shall, therefore, consign what we have to say upon it, to the present section. A few preliminary observations may be proper.

Milk is the well known basis of all the operations of the dairy. Few things have more engaged the attention of chemists. Boyle, Boerhave, Hoffinan and Macquer, all the old school and many of the new,(1) have employed themselves in detecting its constituent parts, and in establishing their several proportions. On the first branch of the enquiry they have sufficiently succeeded, and we accordingly know, that this very important fluid is principally composed of an oily matter, of curd, of an essential salt, called sugar of milk, and of serum. But on the other branch of the enquiry, so various have been the results of experiments made on the milk of different animals, and of the same animal at different times, that it continues to be the reproach of chemistry ; and we have now before us the acknowledgment of M. Perthuys, of the French Institute, that “ to determine these proportions with the necessary exactness is *impossible*.” Fortunately, however, the pride of science is more affected by this failure, than the interests of agriculture.

Milk, is reducible to two species ; that of ruminating animals, and that of animals which do not ruminate. Milk of the first description, abounds in cream and in curd ; that of the other, in sugar and whey ; and it is on this distinction that the milk of cows, sheep and goats is principally employed for the purposes of the dairy, while that of mares and asses is, with similar propriety, yielded to the service of medicine.(2)

(1) Haller, Brisson, Deyeux, Parmentier and Fourcroy, &c. &c.

(2) The medical uses of asses' milk have come down to us from Hypocrates and

Observation has shown, that this secretion is much influenced by circumstances of weather, of aliment and of age. A stormy day lessens its quantity and alters its quality; bad or deficient food has a similar but greater effect, and the fact is well known, that very young and very old cows give poor milk. Mild weather, on the other hand, promotes the secretion, and soft nourishing aliments, easy of digestion and in sufficient quantity, make it redundant.

A fact, established by the labors of Messrs. Deyeux and Parmentier, and long before known to the dairy maid, is, that the milk first drawn is serous; that that which succeeds is less so, and that what are commonly called *strippings*, are nearly all cream.

Having premised these facts, we proceed to the business of butter-making—the theory of which is reducible to the following heads:

1st. Butter is found suspended in milk, in the form of a white and liquid oil. This suspension is the effect of the saccharine matter and the curd, which are among the component parts of milk.

2d. In a state of repose and in a cool temperature, this oily matter separates itself, in a great degree, from the serum and curd, mounts to the surface and there forms a pellicle of greater or less density.

3d. When in contact with atmospheric air, it draws from it a portion of oxygen, and thence acquires a yellow color and disposition to harden.

4th. Agitation and pressure are necessary to sepa-

Galen. The milk of mares is only established in the pharmacopia of Tartary; where, according to the reports made by travellers, it is food, physic and brandy.

rate it from the serum and curd, which may have mounted with it. And,

5th. To correct its tendency to decomposition, which first shows itself by a rancid smell and taste, it must be subjected to the action of heat, or a portion of the muriate of soda must be incorporated with it. From this theory of butter-making, it will be easy to deduce the rules necessary to practice.

1st. The formation of cream, is, as we have seen, a process of nature, which we best promote by giving to our dairies a northern exposition; by keeping them perfectly clean; because filth, besides other mischief, is predisposed to fermentation, and is, of course, productive of heat; and lastly, by so forming our pans as to make them narrow at the bottom and wide at the top, to the end that they may offer to the atmosphere the largest possible surface.(1)

2d. The separation of the butter from the milk, with which it is still connected, is our own labor, and must be carefully and thoroughly performed. This is called churning, and ought to be only a moderate and continued agitation. If the movement be too slow or frequently interrupted, the effect intended is not produced; and if hurried and violent, the cream is too much heated and yields a white and curd-like butter. When this operation is well performed, the butter is found adhering to the staff and flyers of the churn, is of an agreeable taste and color, and of a certain degree of consistency.

3d. To increase this last, and more perfectly to

(1) See, in Fourcroy's Chemistry, vol. ix. the effects of covering milk pans.

discharge the milk from the butter, the latter is again subjected to frequent pressure and washing in cold water, which, readily uniting with the milk, carries it along with it.

4th. What now remains is, to employ the means necessary to its preservation. These are of two kinds; a small portion of common salt, well dried and pulverised, may be wrought into the mass, and distributed as equally as possible; or, the fresh mass subjected to a demi-fusion, will throw up a frothy and feculent matter, which must be carefully taken off; and which, if neither evaporated nor skimmed in this way, nor absorbed by the salt in the other, would produce the rancidity of which we have already spoken. The butter of Prevalais, the finest in Europe, is prepared after this last mode. The secret was long and well kept, but was at length divulged by M. Tessier, about the year 1809.

Of Cheese-making.

The *curd* of milk is known to be the basis of *cheese*, and the theory of making this may be brought under three heads:

1st. *Turning the milk*, or separating the curd from the other constituents of milk, by a chemical process, or by permitting it to separate spontaneously.

2d. *Expressing what remains of these from the curd*, by mechanical means; and,

3d. *Seasoning the mass*, by the introduction of some matter of conservative quality, as muriate of soda, sage, balm, aromatic clover, &c. &c.

These principles may be much varied, and, under different managements, will produce cheeses of very

different species, which may, however, be generalised as follows :

1st. Those in the fabrication of which the coagulation of the milk is spontaneous. This species retains a great degree of softness, is peculiarly liable to decomposition, and is therefore used in a short time after being made. Such is the cream-cheese, and the cheeses of Viry, Montdedier, and Mont d'Or.

2d. Those which have been deprived of their serosity, by means only of compression. Such are the cheeses of Holland, of Cantal in France, &c. And,

3d. Those to which have been applied, not only the action of the press, but of fire. Such are the cheeses known by the names of Gruyere, Parmesan and Cheshire.(1)

Of these different species, it is our intention to speak only of the second and third, because these form the cheeses of commerce, and have most connection with the public interest.

Turning the milk, which is the first step in the process, may be effected by many different substances, such as vegetable acids and astringents; but the matter generally, if not universally employed, is either the second stomach of the calf, or its contents, which are called *rennet*. A portion of either put into the milk, (which must be left in a state of repose,) will in a few hours produce the desired separation. The quantity of rennet employed is not, however, a mat-

(1) The *Schabzieger* (cheese made in Switzerland) is of a different kind. Instead of the curd, the Swiss employ the sediment of the serum, and macerate in it a few of the leaves, stems or seeds of the trifolium oderatum, or blue clover. It is this which gives to the Schabzieger its peculiar and highly aromatic taste and smell.

ter of indifference. If too much be used, the curd will remain in parcels, without consistency, and altogether deprived of the cream of the milk. If, on the other hand, the quantity employed be too small, the separation of the curd from the serum will not be complete. The exact quantity necessary is an affair of experience, which only a number of trials on different portions of milk, enables one to regulate and adjust. A circumstance of still greater importance, but of less difficulty, is that of determining the character of the rennet. If this emit any strong or disagreeable odor, it is bad, and should not be employed, as it will infallibly communicate to the curd its own offensive qualities.

As soon as the curd is separated, it must be broken into pieces, so that the serum, which is now collected into little cells, may have the means of escaping. By this operation the curd is reduced to a paste, which acquires coherency as fast as the fluid is separated from it. This paste is now put into moulds and compressed until a farther portion of the moisture is expelled. When this effect is produced, the curd is again divided, squeezed by the hand, replaced in the moulds and subjected to heavy weights, which expel the last remaining drops of the whey. If the weather be warm, the cheeses will swell and cavities appear on their surfaces—an effect of the disengagement of air, which is the sign of interior fermentation, and the signal for removing the cheeses to the drying room, and beginning the application of salt to their surfaces and sides. This application must be continued daily, and the cheeses be turned

as often, so that the salt be equally distributed throughout them. If they present a dry surface, they should be wetted with salted whey, and if a frothy appearance, they should be carefully wiped and the outer rind scraped with a blunt knife. They will soon acquire the necessary hardness and the proper color.(1)

In these operations we have described the mode of making cheeses deprived of their serosity, by *compression* only. What we have yet to say, applies to those, in the making of which, *fire* is a necessary agent. The milk, destined for these, is placed in a boiler and on a moderate fire ; the rennet is then applied and the milk stirred without interruption. The moment the action of the rennet becomes apparent, the boiler is taken from the fire and the contents left undisturbed. A coagulation soon takes place, when a portion of the serum must be removed, and the remaining portion be left to boil the curd, which is seen floating in distinct parcels or lumps. The boiler must now be replaced on the fire, and the mass be continually stirred, until the curd takes a degree of coherency. When this effect is produced the boiling is complete, and the curds, collected into masses, are taken from the serum and committed to moulds. The press is now employed and the salt applied, as in the preceding directions. During three weeks, or a month, the moulds are gently and gradually tightened, and so soon as a superabundant moisture ap-

(1) The Italians employ safron, and the English the bixa, to color their cheeses. These are only expedients to make *new* cheese pass for *old* in the market.

pears on the surface of the cheese, the salting is discontinued.(1)

Various means have been used to improve the qualities of cheese, besides those employed in the process of fabrication. Though we give little credit to these devices, still, as others may have more faith than ourselves, it may not be improper to mention some of them. The most simple and most easily employed are—rubbing them with oil, with butter not salted, with the lees of wine, and sometimes enveloping them with linen, dipped in vinegar, or in new hay, moistened with warm water. Another, more compounded and not so easily obtained, has fallen within the scope of our reading. It is given by M. Chazotte, inspector of mines to the Duke of Parma, who says of it, “that cheeses the most dry and of the worst quality, if moistened daily for twenty or thirty days, with a liquor composed of strong vinegar and alkalised nitre, and which entirely resembles the *foliated earth of tartar*, known to chemists and physicians, will render them excellent.” What, on this head, is suggested by our own experience is, that if not made better, they are assuredly best preserved, by dark apartments, neither very dry nor very humid, and by shelves or tables frequently washed, and not containing in them any resinous matter.

Of the residuum or whey left after cheese-making.

This is not without its uses, and some of them important. The medicinal virtues of whey have been long acknowledged and much celebrated, and ap-

(1) This appearance shows that the absorption of salt is complete.

pear to be beyond even the reach of time, which has neither abated their force nor diminished their fame ; for, when all other remedies fail, the modern valetudinarian, like the ancient, is dismissed to mountain air and whey diet. The lives of literary men furnish many striking instances of its nourishing as well as its medicinal properties. Boerhave persevered in the use of it, to the exclusion of other food, for many months ; and Furguson for many years. Its effect in fattening hogs is universally known. This nutritive property exists in the mucus sugar with which it abounds ; the extraction of which has long employed the science and industry of the Swiss cantons.(1)

(1) See Lichtenstein and Rocol, on the sugar of milk. The maximum of its quantity 1-28th ; the minimum 1-60th. Scheele has shown, that this saccharine matter differs essentially from the sugar of canes. See Fourcroy's Chemistry, vol. ix.

THE END.

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