GEORGICAL

ESSAYS:

BY

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NISI UTILE EST QUOD FACIMUS STULTA EST GLORIA. *Phæd.*

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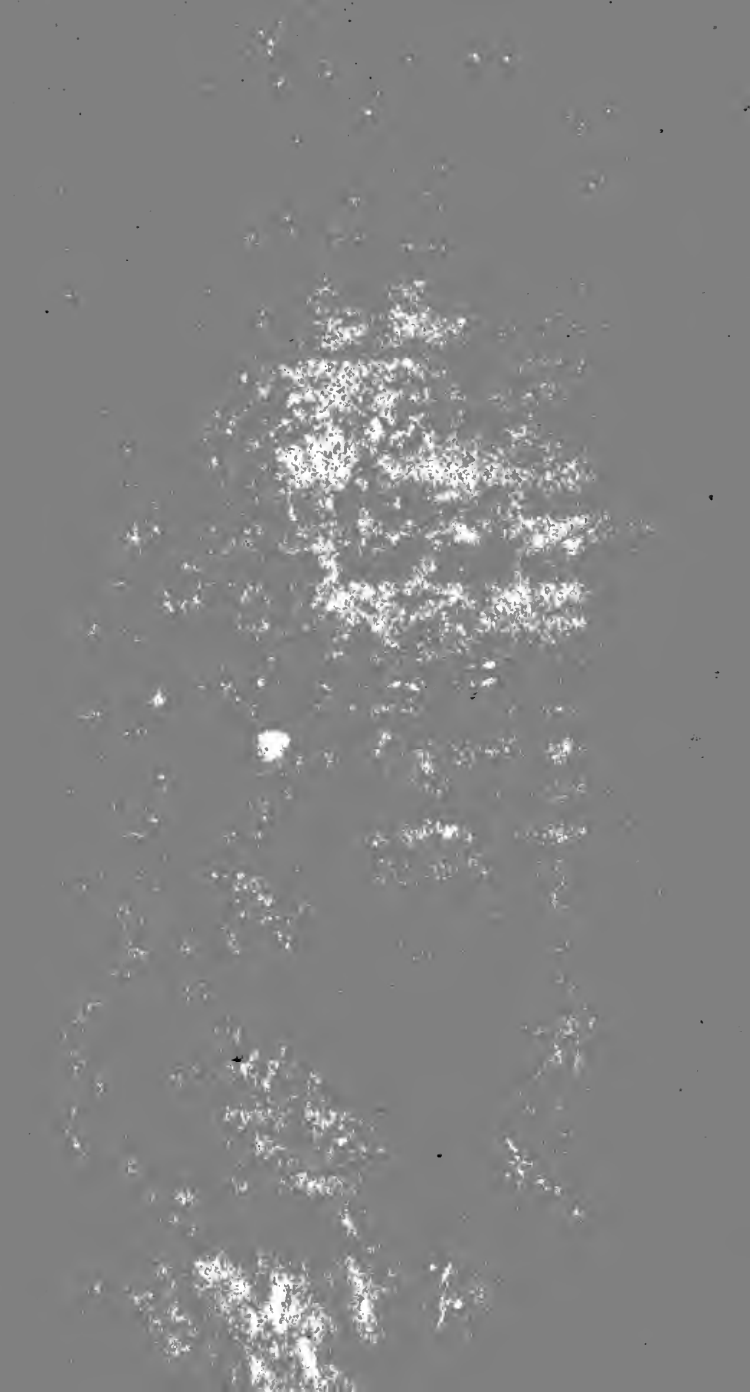

GEORGICAL ESSAYS.

ESSAY I.

On the various degrees of Heat in living and dead Bodies.

1. *Of the way of computing the different degrees of Heat.*

MANY of the ancients entertained strange notions of the nature of heat. They supposed it in different subjects to differ in kind as well as quantity. They talked of the Celestial Heat, as differing much in its nature from the heats commonly produced on our earth. And these, too, they thought to be of quite different natures in the different bodies wherein they are lodged. The heat of the fire, or of hot water, or of fermenting substances, they considered as altogether distinct from the heat of animals. And this they distinguished into natural and preternatural, or

morbid, as sorts of heat quite different from one another. And those, too, they reckoned of different natures in the different species of animals. Doctrines and ways of speaking of this sort, set up by the Peripatetic school, and too much adopted by Galen and the physicians after him, continued long in the world; and were also countenanced by the chymists, who profeſsed and valued themselves on a more than ordinary knowledge of the secrets and operations of heat.

Gomez Pereira, who was amongst the first that dared to think freely in philosophy as well as physic, ventured to affirm* all heat, whether of an elementary, igneous, or animal kind, to be of one and the same nature; that the heat of the sun, or any other elementary heat, did not differ from that of animals but in degree; and that the heat of a man in a fever differed only by its exceſs from that of a man in health; and that the heats of other animals did not differ specifically, but only in quantity, from one another, or from that of the human kind.

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* Nov. Med. cap. ii. p. 7, 9. cap. iii. p. 12, 17, 20, 23, 24, 25.

The learned Telesius, though he was sensible of the great variety of the degrees of heat in bodies, thought that the determining them and ascertaining their differences to be almost impossible. So that he declines taking the trouble of any such inquiry.

How fond would he have been of the ways of measuring heat found out since his time? Though for his own part he absolutely despairs of doing it, especially with any tolerable accuracy.

The nature of heat my Lord Verulam seems to have considered with more than ordinary attention; and gives his doctrine *de forma calidi**, by way of example for managing philosophical subjects. He found all the various heats not to differ in kind, but in their various intensities, durations, and other modifications and accidents †.

Sanctorius' thermometer, given out to the world about that time, showed all kinds of

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* Nov. Org. II. 11, 12, 13, 18, 20,

† Ibid. p. 189, 196, 197, 200, 206, 208, 220, 252, 253, 254.

heat to have a similar effect in dilating the air; according to whose various expansions, the various intensities of those heats, of whatever kinds, were to be judged. The same was soon found to hold in other fluids. And at length the firmest bodies themselves were, by undeniable proofs, found to swell by the application of heat of any sort. And from the various degrees of those dilatations alone we must take our measures of the various degrees of heat in bodies.

But where shall we begin to reckon the heat of bodies, or their greatest natural contractions, or the limits of heat and cold? Many things, when first proposed, look singular and odd, that, after laying aside prejudices, by mature consideration become familiar and easy; and of the truth of which we come at length to be fully satisfied. We commonly conceive water, when once frozen and turned to ice, to have lost all heat, and so to have become absolutely cold; on which account many philosophers did too hastily begin their reckonings of heat from this point. But as various fluids, such as melted wax, melted tallow, oil, wine, brandy, &c. lose their fluidity at various degrees of heat, and after that may

still grow colder and colder in their firm state; just so, after water begins to freeze, we know from many considerations it can become still much colder. That is, that in frozen water there is still a considerable quantity of heat; which by degrees grows leſs and leſs, till the cold becomes intolerable to us mortals; as in the dead of winter in the northern intemperate climates, where men cannot live without more than ordinary shelter from the extreme severity of the weather. The air is oftentimes as much colder than water beginning to freeze, as such water is colder than our summer weather. We reckon it warm when the fluid in the thermometer is raised to gr. 64; it is at gr. 32 when water freezes; and such colds have been often seen as to bring it down to gr. 0, the beginning of the scale, nearly the cold produced by a mixture of snow and salt.

Not as if this was the lowest degree of heat, or the greatest degree of cold that nature has ever been observed to produce on our earth, as Dr. Boerhaave * seems to think, and which he †, though I know not on whose

* Chem. I. p. 162, 164, 166, 399, 400, 593.
† Ibid. p. 158, 166. 174.

testimony, tells us was the greatest cold that was observed in Iceland in the cold winter of $170\frac{3}{9}$. The cold has been sometimes felt as great, or near as great as this in climates ordinarily temperate enough, and certainly much warmer than what we have reason to believe the bleak cold country of Iceland to be. At Germanopolis in Pennsylvania, only in the latitude 40°, an. $173\frac{1}{2}$, the cold brought the mercury to gr. 5 *. In the famous winters $170\frac{8}{9}$ and $171\frac{5}{6}$, the cold at Paris was such, that it would have brought down the mercury in our thermometer to gr. 8 †. At Leyden, an. $172\frac{8}{9}$, it sunk to gr. 5 ‡, and at Utrecht it fell a division lower ‖. At London, in the winters $170\frac{8}{9}$, and $173\frac{0}{1}$, the cold was so violent as to bring the spirits almost down to the artificial cold of an ice and salt mixture §: and an. $170\frac{8}{9}$ Olaus Roemer**, at Copenhagen, in the latitude of 55 deg. 43 min. found the

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* Act. Berolin. Cont. IV. p. 130.

† Mem. Acad. Sc. 1710, p. 186. 1717, p. 3.

‡ Boerh. Chem. I. p. 158.

‖ Muſschenber. in Phil. Trans. 425. p. 359.

§ Derham in Phil. Trans. Abr. IV. 2. p. 113. VI. 2. p. 50.

** Vide Boerh. Chem. I. p. 720.

mercury in his thermometer to fall fully thus low, to wit, to gr. 0 *.

But if we go farther north, though not so far as Iceland, we shall meet with much greater colds than any thing ever seen in these countries. In January 1732 the cold was so great at Upsal, that it brought the spirit of wine in one of the Royal Society's thermometers down to gr. 124, which falls about a degree below gr. 0 in Fahrenheit's. And at Petersburgh in the latitude only of 59° 56′, much the same with that of Upsal, an. $173\frac{2}{3}$, the cold was so excefsive, that quicksilver was by it contracted $\frac{1}{50}$ part of the bulk it had in boiling water, or to fall to gr. 200 in De l'Isle's thermometer; which † brings it to — gr. 28

* Dr. Boerhaave speaks of this remarkable observation of Olaus Roemer as made at Dantzick. But I rather think it to have been made at Copenhagen. Dr. Derham (see Phil. Trans. Abr. IV. 2. p. 114.) had papers in his hands giving an account of this very frost, an. $170\frac{8}{9}$ at Copenhagen, said to have been taken from the observations of Mr. Roemer: and Mr. Roemer was a Dane, lived and bore high offices at Copenhagen, and died there an. 1710. However, in the main, this does not at all alter the srory with respect to us.

† Phil. Trans. 441. p. 222.

in ours. We know in general, from the accounts of travellers, what intense colds rage in winter in many places of the world, and especially in or near the frigid zones in both hemispheres. But we have few observations on record exactly limited or reduced to a determined measure. However, in M. de Maupertius's * accurare journal, we find that the French academicians, who, in pursuit of knowledge, and to determine that important question of the figure of the earth, wintered an. $173\frac{6}{7}$ at the north polar circle, experienced a degree of cold much greater than any thing we find measured and recorded by others. At Torneao, in the latitude of 65° 51′, even on this side that circle, their spirit of wine thermometers came at length to be frozen, and, a mercurial one, constructed in Mr. de Reaumur's way, sunk to gr. 37 under his freezing point, which would have been about 33 divisions below gr. 0 in Fahrenheit's. When that intense cold was suddenly admitted into their warm rooms, their bodies could hardly suffer it, their breasts were as if they had been rent, and the moisture of the air was in an instant converted into whole

* Fig. de la Terre, p. 58.

flakes of snow. This is a degree of cold as much below the cold of freezing water, as that is below the ordinary heat of our skin: for it is 33+32=65 divisions below the freezing point at gr. 32, and the heat of the human skin at gr. 97, is just so much above it.

To find a cold so far below that of freezing water is certainly very surprising: and yet a greater than this almost inconceivable degree of cold, may by art be procured in leſs rigid climes: for we can contrive a method of cooling much beyond the ordinary tendency and course of nature. Many things when mixed together immediately become much colder than formerly, when they subsisted distinct from one another. Spirit of nitre poured on beaten ice or snow brings on a very intense cold. These, when their temperature and that of the air was but about gr. 32 above gr. 0, the ingenious and industrious Fahrenheit, by an artful management, cooled so much, that the mercury in the thermometer sunk to — gr. 40, or 72 divisions below the freezing point*; a degree of cold greater than what was felt in

* See Boerh. Chem. I. p. 162. Muſschenbr. Tent. Exp. Acad. Cim. Ad. p. 174.

the neighbourhood of the polar circle; and this is as much below the cold of freezing water, as that is below the heat of our hottest animals, or of men in fevers. No body would have thought, *a priori*, that freezing ice was capable of such an additional quantity of cold.

Nor are we absolutely sure that yet in these circumstances all heat was destroyed. Even in that horrid and most bitter cold at Torneao, which the French mathematicians mention with so much horror, we are sure there was; and likewise even in that excefsively cold mixture of Fahrenheit, there might still be, and probably there was, some degree of heat. What if there was a concourse of such frigorific circumstances? If Fahrenheit's experiment was to be made in the frigid zone, what would be the effect, and what a dreadful cold might by that means be produced *? So then, for

* When I was lately at Paris there were put into my hands some very extraordinary observations, communicated to the Royal Academy of Sciences by Mr. De l'Isle at Petersburgh, of excefsive colds at Kirenga in Siberia, a place not very far north, lying in the latitude only of 58°, 10'. There in the winter 1737 the mercury once fell to gr. 275 in De l'Isle's thermometer, which by calculation I find should be gr. 118 below the beginning of

want of knowing the ultimate limits of heat and cold we cannot determine the geometrical proportion of the real or absolute quantity of the heat of one body to that of another. All we should pretend to, is to assign their arithmetical differences; which is a very useful work, and is to be done by a great number of accurate observations on the various expansions of bodies by the various degrees of heat; these expansions always corresponding in some measure to the quantities of fire or heat applied. So that we shall in the ordinary way speak of these things as proportional to one another. Though I would not be understood positively to affirm that they both go on always precisely in the same ratio; or that the expansions were always exactly in a ratio neither greater nor less than the simple ratio of the quantities of the applied heats.

When people * tell us that red-hot iron is

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the scale in ours. This, if there be no mistake in the affair, is the most astonishing thing I ever met with of the kind. It supposes a cold 150 degrees below the freezing point, almost an incredible thing; a cold as much below the cold of freezing water, as that is below the heat of boiling spirit of wine.

* Vid. Newton Princip. p. 508. and in Phil. Trans. Abr. IV. 2. p. 2, 3. Pitcarn. El. Med. II. 1. § 26.

3 or 4 times hotter than boiling water, and that boiling water is about 3 times hotter than the heat of our skin, or of the summer heat, they generally reckon the lowest limits of heat to be where water begins to freeze; and thence found the additional dilatations of quicksilver, or of linseed oil (or of any other fluid that may be used in such thermometers) to be in these proportions; though the absolute or real quantities of heat in these bodies do not differ so much by far, as they by that mistaken way of reckoning computed. Thus boiling water indeed raises the mercury in the thermometer to gr. 212, that is 180 divisions above gr. 32, the heat of freezing water, while the heat of the human body is but about gr. 97 or 98, only 65 or 66 degrees above the freezing point. And therefore the dilatation acquired from that point by the heat of boiling water, to the dilatation acquired by the heat of our body, is in the proportion of 180 to 66, or 2'73 to 1; which is something lefs than triple. But the real heats of these things are still lefs differing from one another. Suppose, for example, Fahrenheit's ice and spirit of nitre mixture of — gr. 40 had been at the lowest boundary of heat, (though there is great reason to think that to be still much lower), and then

we shall find that the heat of boiling water should be to that of our bodies only as 212+40 to 98+40, or 252 to 138, or 1'83 to 1: that is, not so much as double. Who, before such a particular examination, would have thought the burning destroying heat of boiling water not to be altogether twice so great as the soft temperate heat of a man in health? And upon the former reckoning of red-hot iron, its heat should be to the heat of our skin instead of 10 or 12 to 1, only as about 700 to 138, or 5 to 1. So that by thus bringing down the limits of heat at least 72 degrees below the ordinary reckoning, we find its various characters as *frost, temperate, warm, tepid, boiling water, red-hot iron,* &c. whatever their arithmetical distances come out to be, are not so different in their real proportions to one another, as is commonly supposed. Though, on the other hand, I would not affirm them to differ so little as Mr. Amontons* reckoned. In whose scheme the air should entirely lose its elasticity, when it is perfectly devoid of heat, (of which however I think we are not well assured,) and then in such a total

* Hist. Acad. Scienc. 1702. p. 8. Mem. 1703, p. 63, 64 to 238.

absence of heat, were it poſsible to procure it, reducing his numbers to ours, the mercury in Fahrenheit's thermometer should fall 431 divisions below the cold of freezing water, or to — gr. 400 p. q.; a degree of cold as much below the heat of the human body, as that is below the burning heat of oil or mercury boiling. But as we are not quite certain about this lowest degree of heat, we must, as I just now said, content ourselves to observe the arithmetical differences of the various degrees of heat in bodies, though we should not be able to determine their real or absolute proportions, until we shall acquire a farther insight into the nature of things than we have at present. It is good to know the narrow limits of our faculties, and modestly to confeſs the bounds of our knowledge: ever keeping in mind that excellent axiom of the Lord Verulam*, "Homo naturæ minister et interpres tantum facit et intelligit quantum de ordine naturæ *opere* vel *mente* observaverit: nec amplius scit aut potest." It must be by this road of experience and observation, pointed out to us by the great Lord Chancellor, if ever we arrive at a higher degree of knowledge than what we at present enjoy.

* Nov. Org. I. 1.

II. *Of the Heat of the Air.*

In our search after the lowest degree of heat, though we could not arrive at it, we found however, in some seasons and parts of the world, exceſsively great degrees of cold, and which the inhabitants of the earth can scarcely bear; they are intolerable both to animals and vegetables. The quarters of the earth, within the polar circles, were thought by the ancients to be uninhabited by reason of the exceſs of cold prevailing there, ανοικητοι δια ψυχος †.

Frigus iners illic habitat, pallorque, tremorque, ac jejuna fames.

"Quia," says Macrobius‡, "torpor ille "glacialis nec animali nec frugi vitam ministrat."

Pigris ubi nulla campis
Arbor æstiva recreatur aura §.

And indeed these bleak wild parts of the

† Diog. Laert. VII. 156.
‡ In Somn. Scip. II. 5. p. m. 110.
§ Horat. Carm. I. 22.

world, though not quite waste, are but thinly peopled. And no wonder. There, and in other disadvantageously situated places, where such intolerable colds chiefly rage, men must shelter themselves in clothes and houses. The beasts of these countries are many of them provided by nature with a thick, warm covering; or must retire the best way they can from the killing colds of winter, which however, often overtake them. The very vegetables themselves would die were they not commonly in these seasons buried under snow to such great depths, as the extreme severity of the cold cannot reach. In bitter black frosts we often experience the fatal effects of the want of this shelter and protection, even in the humbler tribe of vegetables. And though there be plenty of snow, the trees and higher shrubs, that are not covered by it, are great sufferers in the extraordinary severe winters, even in the more happy and otherwise more temperate countries. As has been often seen, and in our own days was experienced through all Europe in the years $170\frac{3}{9}$, $172\frac{3}{9}$, &c.*; when the thermometers pointed these low

* Phil. Trans. Abr. IV. 2. p. 120, &c. Mem. Ac. Sc. 1710, p. 186. Hales, Veg. Stat. p. 74, &c.

degrees of heat we had formerly occasion to mention.

But these and such like excefsive colds are in these parts of the world justly looked on as a sort of irregularities, and out of the ordinary course of things. In these temperate climates of ours, the mercury seldom falls under gr. 16. And even then it is extraordinary cold. And indeed we are apt to reckon it very cold at gr. 24. By the very construction of the thermometer it is slight frost at gr. 32: and continues coldish to gr. 40, and a little above it.

The middle temperature of our atmosphere in these countries is about gr. 48. when we cannot call the weather either hot or cold; and is, as it were, a medium of all the seasons, coinciding pretty nearly with the middle vernal and autumnal heat, as observed in England by Sir Isaac Newton, and Dr. Hales, and by Mr. Crucquius in Holland. The French raise this middle temperature a little higher. They reckon it equal to the heat of the cave of their Royal Observatory: and this, both by observation and a calcul, comparing it with Mr. Amontons's thermometer, I find to be at gr. 53 in Roemer's. And indeed

this middle temperature of the air we may easily conceive to be very different in different countries. It is to be reckoned as a relative sort of thing, varying according to the various climates and constitutions of bodies in them, which by use come to be fitted to different temperatures. In the cold countries the air will be found agreeable enough to the inhabitants while it is betwixt gr. 40 and 50. In these middle climates in our neighbourhood, and not too far south of us, we are best pleased with the heat of the air from a little under gr. 50 to gr. 60; while in the hot countries they have their air generally, and can well bear it, something both above and below gr. 70.

When the heats in the respective climates are either much higher or much lower than these, both men and beasts are fain to provide against them the best way they can. In the cold they shelter themselves in houses, dens, holes of the earth, &c.; and the human kind beside that provide for themselves clothes and fires, to protect them from the severity of the weather. In the heats we lay aside our clothes, or take to the lightest sort; we shun the mid-day air, and retire to the coolest

places; for in the day-time it is generally warmer in the open air than in houses. And some of the bird kind choose to shift their country in the different seasons of the year, finding always by this means, a climate sufficiently temperate for their constitution.

But the same degree of heat is not equally fitted to all animals. Some kinds naturally choose a cold country, while others indulge themselves in a warmer climate, and find that better fitted to their constitutions. And so too, though with Dr. Hales* we should deem the most genial heat for the generality of plants to be from gr. 53 to gr. 69, the various classes of vegetables have their various temperatures of the air in which they can thrive best. Every body knows that some plants can live only in the cold countries, being burnt up if transplanted to a more southern soil; while the natives of the warm countries are chilled to death with us, if not very carefully and artfully protected from the injuries of our severer weather. This piece of culture, proposed long since by the great Lord Veru-

* Veg. Stat. p. 59.

lam*, has been, in our time, carried to a surprising height. With the help of thermometers we can so adjust our stoves, green-houses, and hot-beds, as to imitate the temperature of any climate we please; and to support and keep in strong life and vigour the plants which nature has given only to the warmer countries. According to the observations of the London gardeners, as marked on Mr. Fowler's thermometer reduced to ours, I find the kindly degrees of heat for some of the most curious foreign plants to be these. For the myrtles gr. 44; oranges gr. 47; ficoides gr. 50; Indian fig gr. 53½; aloe gr. 57; cereus gr. 60; euphorbium gr. 63; piamento gr. 66; ananas gr. 70; melon thistle gr. 73.

Not as if these plants could bear only such and such precise points of heat. They, like other vegetables and animals, have a considerable latitude that way; and can suffer the air both colder and warmer than these degrees, which, however, are reckoned most adapted to their nature. Though I suspect some of them are marked too low, being far under the ordinary and most kindly heats in

* Nov. Org. II. 35. p. 254, 50, p. 348. Nat. Hist. 401, 405, 412, 856.

those countries where such plants naturally grow. But there indeed, they have a freer and more open air; where consequently they can bear greater heats than in our smothered and pent-up stoves and green-houses.

Even we in this country do not reckon the air warm till it arrives at about gr. 64. It is to us very warm and sultry at gr. 80. And Dr. Boerhaave* thought it naturally scarce ever exceeded gr. 80 or 90 at most, reckoning such hot air would soon be destructive of the life of animals. But sometimes, even in these temperate climates, the weather has been found much hotter. I find observations recorded of the weather at Utrecht, Paris, Padua, &c. having sometimes been observed so hot, as that the mercury in our thermometer would have been raised to above 90 degrees. In Pennsylvania, not an intemperate climate, the heat in summer 1732, came once to be gr. 96 or 97†. And Mr. Reaumur‡ promises us observations of heats that people were obliged to suffer, though they reached to gr. 38 in his thermometer, or near gr. 104 in

* Chem. I. 156. p. 192, 207, 213, 274, 278, 553.
† Act Berolin. Cont. IV. p. 131.
‡ Mem. Acad. des Sc. 1736, p. 486, 489.

ours. Even in the more northernly countries, where the sun has leſs influence, we can by art contrive a method of giving undeniable evidence of animals being able to bear a still greater warmneſs of air. In the outer bagnio at Edinburgh, the heat used to raise our thermometer to gr. 90, where, though at your first entry it seemed indeed a great deal too hot, and something disagreeable, yet it soon became so very tolerable, that one might without any uneasineſs, have continued in it as long as he had thought fit. Even one could stay some hours in the inner bagnio, though the heat there used to be about gr. 100.

From all this we see how finely every thing has been contrived and adjusted by the great and wise Author of Nature, and what a vast latitude of the heat and cold of the air the animal body, especially that of man, can bear, from the sultry burning heats, as hot or hotter than his blood, down to the chilling colds a good deal below that of freezing water; though indeed it is about some intermediate distance betwixt them, where the heat is most agreeable, or best tempered to the bodies of animals and vegetables.

It was only the middle climates or temperate zones that many of the ancients imagined were habitable by us mortals.

——Mortalibus ægris
*Munere concessæ divûm**.

Macrobius† says, "Tantum vitales auras "natura dedit incolis carpere." Accordingly much was said long ago of the intolerable heat of the torrid zone, as by that means uninhabitable by men: whence Ovid ‡, speaking of the zones of the earth, says,

Quarum quæ media est non est habitabilis æstu.

Virgil§ says the same thing in a more pompous manner.

——Quarum una corusco
Semper sole rubens, et torrida semper ab igni.

And Horace‖, with his ordinary poetical imagery, supposes himself placed,

Sub curru nimium propinqui
Solis, in terra domibus negata.

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* Virgil Georg. I. 237.
† In Somn. Scip. II. 5. p. m. 110.
‡ Metamorph. I. 49.
§ Georg. I. 234.
‖ Cram. I. 22.

Tibullus* expreſses the position of this part of the earth, and its consequences, more fully than any of them, in these lines:

Media est Phœbi semper subjecta calori,
Non ergo preſso tellus consurgit aratro:
Nec frugem segetes præbent, nec pabula terræ.
Non illic colit arva Deus, Bacchusve, Ceresve,
Nulla nec exustus habitant animalia parteis.

But this opinion was, I humbly think, among their vulgar errors, received chiefly by the people, and taken up by the poets as a beautiful fiction, which we cannot well suppose they really believed. The wiser sort, though they sometimes spoke† like other folks, knew better things. Their historians and geographers have recorded tolerable good accounts of some of the middle parts of the earth within the tropics. Æthiopia, Arabia Felix, the sea-coasts of India, the isle of Taprobana, Ophir, Tarshish, &c. were known even by the common people to be well inhabited, though lying within the torrid zone:

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* Eleg. IV. 1. in Meſsal.

† See Cicer. Somn. Scip. 6. Macrob. in Somn. Scip. II. 5, 6, 7. Diog. Laert. VII. 156.

and the travels of the ancients, as well as ours, showed these countries not to be disagreeable or inconvenient for human life. Nay, the heats there are by no means so excesive as we are all, before trial, ready to imagine and expect. The Jesuit missionaries to the East Indies * took particular notice of this: and their capacity of observing such things, and their fidelity in relating them, no body will call in question. And lately the curious Mr. Cossigny's thermometrical observations † show, that the ordinary heats, even under the line, and near it, are not greater than what have been in some extraordinary seasons observed at Paris, and other places, that every body knows to be temperate enough.

It is true all these observations were made in islands, and on or near the sea-coasts, which we may presume to be somewhat cooler than the inland countries ‡. But still we are well

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* See Du Hamel Hist. Ac. Sc. p. 272, 273. Hist. Acad. Sc. 1666—1698, II. p. 111, 112. Mem. Acad. Sc. 1666—1698. VII. p. 835.

† Mem. Acad. Sc. 1733, p. 580, &c. 1734, p. 759, &c.

‡ See Mem. Acad. Sc. 1666—1698, VII p. 837.

assured, that even these can easily enough be borne with. And all these parts of the world have that advantage of the weather, being there much more uniform than with us. Their air suffers much smaller changes both in the incumbent weight of the atmosphere pressing it, and in the degrees of heat wherewith it is warmed. Dr. Halley * tells us, that he, as well as others † who have sojourned within the tropics, found very little variation in the height of the mercury in the barometer, which we know to be two or three inches in the more northern regions; we are all but too sensible of the vast changes of the temperature of the air in this quarter of the world, which through the whole year is commonly found so equable in the torrid zone. At Siam, within the lat. 15 deg. from the greatest winter cold to their highest summer heat, the Jesuits experienced a difference only of 26 degrees in Hubin's thermometer ‡, the extent of which I believe differs not much from the like num-

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* Phil. Trans. Abr. II. p. 18, 20, 22.

† Vid. Mem. Acad. Sc. 1666—1698, VII. p. 840.

‡ Du Hamel Hist. Ac. Sc. p. 272.

ber in ours. In Batavia *, though a very hot place, and in gr. 6 south lat. the excefs of heat above the greatest cold was still something lefs: and in Malacca †, but 2 deg. of latitude from the equator, the weather is very temperate, and so equable, that for seven months together the spirit in the thermometer was never under gr. 60, nor above gr. 70. In the isle of Bourbon ‡, in the lat. about 22 degrees the difference between the highest and lowest afternoon heat in a twelvemonth's time was but eight divisions in Reaumur's thermometer, which makes up scarcely fifteen in ours: and the ordinary difference of the night and day heat in these climates was found a small matter compared to what we have it commonly with us §. And as the torrid zone excels our countries hereabout in a more equable degree of heat and weight of the atmosphere, so we are more happily appointed that way than in Sweden and Lapland, and these other

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* Du Hannel Hist. Ac. Sc. Ibid. p. 272.

† Ibid.

‡ Mem. Ac. Sc. 1734, p. 762.

§ Ib. 1666—1698, VII. p. 837, 1733, p. 537.

northern regions*. From whence it would seem a general rule, that, *cæteris paribus*, the greatneſs of the viciſsitudes of the air increases with the latitudes of the places as you go from the equator.

III. *Of the comparative heats of the Sun, Earth, Planets and Comets.*

We have hitherto considered the air, though influenced by the sun, as shaded from its immediate burning operation. For in the open air, exposed to its direct beams shining with greatest advantage, the heat is found much higher than any thing we have hitherto been speaking of. And an examination of this will naturally lead us into the consideration of the heat of the sun, the inexhaustible magazine of light and fire, the great furnace of our system; and to consider its influence on bodies placed at different distances from it.

Sir Isaac Newton†, comparing the sun's in-

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* See Phil. Trans. Ab. II. p. 22. Maupert. Fig. de la Terre, p. 72.

† Princip. III. Prop. 8. Cor. 4. p. 406.

fluence on the Earth and Mercury, which by its vicinity to the sun should have seven times more heat from him than us, reckons the solar heat in that planet sufficient to boil our water, and quickly carry it all off in vapour; having found by a Thermometer that water was boiled by a heat seven times greater than the heat of the summer sun; which then in this reckoning should be only at gr. $(32+\frac{168}{7}^{\circ}=)$ 58. But this expreſsion of the heat of the summer's sun must be greatly modified to be consistent with the true state of things. He must not only have meant it solely of the degrees above freezing water, (as was then the fashion of thinking and speaking,) but also instead of summer sun, he must really have understood the ordinary shaded air in summer, or the summer heat of the air, as Dr. Pitcairn* (who I suppose had his observations of this matter from Sir Isaac) expreſses it. Though I must confeſs that this could be but very improperly compared to the solar heat at Mercury; except we suppose that he likewise meant the heat in the shade at Mercury too. And farther, it

* Elem. Med. II. 1. § 26.

will be reckoned an incongruous way of judging of the heat of the sun, by taking our measures from its impaired action on the air screened from its direct rays.

The direct summer mid-day heat is vastly greater than such a low allowance; it having been found, even in these northern climates, able to dilate the fluid in the Thermometer much more than $\frac{1}{7}$ of the dilatation caused by boiling water. Dr. Boerhaave is the lowest in his reckoning of any that pretended to take an estimate of it, saying*, that the greatest heat ever produced by the direct action of the sun in our air, or other bodies heated by it, seldom reaches to gr. 84. And at another time†, though he raises it a little higher, seeming to allow that the great dog-day heat may come to gr. 90, he thinks it can scarce ever go beyond these bounds, or arrive at the heat of the human body. But Sir Isaac himself, in another place of his book‡, expresly tells us, that he found the heat of boiling

* Chem. I. p. 213.

† Chem. I. p. 156.

‡ Princip. p. 508.

water only about three times greater than the heat communicated to dry earth by the summer sun. And so, too, Dr. Muſschenbroek * reckoned it probable that the heat of boiling water is three times greater than the greatest heat communicated to bodies by the summer sun in his country; by these reckonings this heat amounting to gr. (32+$'\frac{8}{3}°$=) 92. Nay, even in Italy, Borelli† and Malpighi‡ found this heat of the sun in mid-summer only equal to the heat of the *viscera* of hot animals, I suppose about gr. 102; not a deal higher than what Newton and Muſschenbroek reckoned.

All this may, I believe, commonly be just and true enough. But it is not so universal, either as to times or places, as one would be ready to expect from such ways of speaking. Lord Verulam‖ long ago took notice, that the highest degree of animal heat scarce ever attained to the heat of the sun's rays in the scorching climates and seasons. And even

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* Tent. Exp. Ac. Cim. Add. II. p. 22.

† De Mot. Anim. II. Prop. 96. 221.

‡ Op. Post. p. 30.

‖ Nov. Org. II. 192.

in this cold country I have experienced greater heats of the sun. Many have had occasion to observe how vastly metals are heated in the sun. Sir Isaac Newton* takes particular notice of this. I have in this place in the latitude of 56 deg. 20 min. seen a piece of iron heated so much that I could not hold it in my hand above a few seconds of time; and therefore it was much hotter than my blood. And I have oftener than once seen dry earth heated to above gr. 120. And Dr. Hales† found a very hot sunshine heat an. 1727 still greater, viz. at about gr. 140. Dr. Muſschenbroek‡ in his later trials once experienced it so high as gr. 150. So that reckoning from the freezing point at gr. 32 in the common way, these strong sun-shine heats were much greater than $\frac{1}{3}$, or even the half of the heat of boiling water. And in the more southern countries it has been found still greater at some particular times. Much has been said of the scorching and intolerable heat of the sun in the torrid zone§. We have

* Princip. p. 420.

† Veg. Stat. p. 59.

‡ Eſs. Phys. § 974.

§ See Boyle Hist. of the Air. Abr. 3. p. 55.

many strange stories of extraordinary summer heats, as great tracts of land, houses, &c. set on fire, stones heated so as to melt lead, &c. These indeed seem extravagant relations. But the German annals* preserve the memory of an excefsively hot summer an. 1230, when they roasted their eggs in the sand heated by the sun. And I have been told that in Egypt, by no means the hottest country in the world, they can often on the tops of their houses roast their eggs at the sun. And to harden the white of an egg I find the heat of about gr. 156 to be neceſsary. In the year 1705 the summer was very warm†. At Montpelier one day the sun was so very hot as to raise the quicksilver in M. Amontons's Thermometer to the mark of boiling water itself, which is our gr. 212.

But after all, these great heats must be reckoned irregularities, and out of the ordinary course of the seasons; and what may be produced by the sun only in certain times and circumstances. For in our temperate climates

* See Lipsii Epist. ad Belg. II. 91.

† Mem. Sc. 1706. p. 15.

the most common and ordinary noontide heat of the summer sun may be found to raise the quicksilver in the Thermometer but about 60 or 70 divisions above the freezing point at gr. 32; and the afternoon heat in the shade about the half of that. So the ordinary summer sun heat with us does nearly coincide with the heat of our body; which was found* to be somewhat more than the half of the heat of boiling water, supposing Fahrenheit's cold mixture to be the very lowest degree of heat; and so too boiling water, instead of seven times, is but between two and three times hotter than our common shaded warm air at midsummer.

However, this solar heat is still much greater in the warmer countries. And if we pretend to make any comparison of such things, it is our equatoreal heat we should reckon as the sun's true heat at our orbit, and what we should collate with its influence on the other planets, or its heat at their respective distances.

But what, on the other side, will lower or

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* Ibid. page 19, &c.

bring down this solar heat very much, is this consideration, that the heat communicated by the sun to bodies on this earth depends much upon other circumstances beside the direct force of its rays. These must be modified by our atmosphere, and variously reflected and combined by the action of the surface of the earth itself, to produce any notable effects of heat. For were it not for these additional circumstances, I question much if the naked heat of the sun would to us be very sensible. We find all our great heats to be in those places that lie low, and have a great height of atmosphere above them, and surrounded by eminences and rising grounds *. If you ascend to the tops of the very elevated mountains, you are chilled with cold, and you find everlasting snows, that after thousands of summers have scarce ever been thawed, though every day exposed to the direct rays of the sun; which in some countries are darted perpendicular on them. We hear that the French

* See Liv. Hist. XXI. 31. Senec. Nat. Qu. IV. 11. Bacon, Nov. Org. II. 12. p. 169. Borell. de Incend. Aetu. p. 7, 50. Boyle Exp. on Cold. Abr. I. p. 639, 658. Hist. of the Air, Abr. III. p. 53, 54, 55. Boerh. Chem. I. p. 172, 185, 476.

virtuosi, who, by order of the king went to America to make their observations on the figure of the earth, &c. found on the very high hills there, just under the line, such excesive colds, that it is suspected they were as intense as what were observed in Lapland itself. So necesary it seems is a long and direct pasage through all or the greatest part of the depth of our atmosphere, or the asistance of its presure, or the reflections of rays from the earth's own surface, to invigorate these rays, and to give them strength for warming terrestrial bodies. To which too the particular sulphureous nature of the low parts of the atmosphere may not a little contribute.

So then there are other circumstances beside the vicinity to the sun that may influence and determine its heating virtue. Thus reckoning the force of heat to be *cæteris paribus* as the density of its rays, or reciprocally as the squares of its distances from the central fire, the planet Mercury is so much nearer the sun than the earth, that its heat from him, by calculation of their respective distances, comes out seven times greater than ours *. And so

* See Newton Princip. III. Prop. 8. Cor. 4. p. 406.

would an inhabitant there feel it, if they have the surface of Mercury disposed like that of our earth, and an atmosphere hanging over their heads so like ours, as to qualify the sun's rays in the same manner. But if they have little or no atmosphere (which seems to be the case of our moon) or an atmosphere so disposed as only to affect the rays of heat in the manner that the upper parts of our atmosphere do, then it is pofsible the solar heat at Mercury may be as tolerable as on our earth. And, on the other hand, though we commonly reckon* that our waters should be frozen up, and we ourselves be chilled to death in the far distant planets Jupiter and Saturn, they may, for ought we know, have their atmospheres and surfaces so constructed, as to render the solar heat comfortable enough even for animals and vegetables of the like nature and pafsions with our own.

But the case of the comets is vastly different from any thing we can propose of the other planets. Their orbits are so eccentrical, that they must be very variously affected by

* See Newton Princip. III. Prop. 8 Cor. 4. p. 405.

the sun in the different parts of their course. But yet their atmospheres and bodies may be of such a nature as that they shall not be heated to such a vast and almost inconceiveable degree as is sometimes supposed. In the Newtonian system of comets * the distance from the sun of that famous one which happeared an. 1680 † in its perihelion was, by calculation, to the mean distance of the earth in the ratio of about 6 to 1000: so that its heat in that part of its period Sir Isaac determines should have been to our summer heat reciprocally as the squares of these numbers, that is, at 1,000,000 to 36, or 28,000 to 1. And therefore, seeing the heat of boiling water is three times greater than what dry earth ac-

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* Newton Princip. III. &c. p. 508.

† It is supposed by many to have been this very comet that appeared an. 1106, an. 531, an. A. C. 44, &c. See Newton Princip. p. 501. Halley Synops. of Comet, in Gregor. Astron. in English, p. 901, 902, 903. Whiston New Theor. of the Earth, p. 187, 191, &c. But M. Caſsini represents the comet, or comets, an. 1680 in a very different manner from these authors: nor does he make that great blazing star that alarmed all Europe, to have been so very eccentrical, or to have come so very near the body of the sun as they do. See Mem. Acad. Sc. 1731, p. 464—468.

quires from the summer sun, and the heat of red-hot iron three or four times greater than the heat of boiling water, he computes the heat of the comet should have been 2000 times greater than the heat of red-hot iron. A prodigious and terrible heat, even with all the abatements we have been proposing; and which I conceive no body can endure, that is not immensely denser and more fixed than any terrestrial body we know. For, from the example of common water, &c. * it would seem that all bodies are, according to their various degrees of density and fixedneſs, susceptible just of such and such particular degrees of heat, beyond which, whatever fire be applied to them, they cannot be raised; though by a heat exceeding these their parts are all diſsipated, are rendered volatile, and fly off in vapour. And yet I cannot but take notice, that all this calculation is upon the supposition that the comet was in its own nature like our earth, and involved in an atmosphere like ours: otherwise that method of reasoning and analogy cannot take place, nor would the sun's heat affect it in that way.

* See Boerh. Chem. I. p. 265, 248.

But I say again, under another view and consideration, what if the real solar heat, both in itself and what it can communicate to us and other planetary bodies, (while it is not concentrated by burning glaſses, or strengthened by other aſsistances,) be vastly leſs that what is commonly reckoned? all the natural heat we meet with here on the earth we are ready to ascribe to the action of the sun, which perhaps has but a small share in it, overlooking a source of heat, which, though often spoke of by the theorists of the earth *, is seldom considered in that advantageous light I would choose to take it. We formerly took notice of what a great stock of heat all terrestrial bodies are poſseſsed, even in the coldest winters. Every body has felt or heard that the temperature of the air in mines and other places deep under ground is warm, or at least very tolerable. And we know, from the

* See Empedocles in Plutarch de Prim. Frigid. p. m. 507. Des Cartes Princip. Phil. IV. 3. Burnet Theor. of the Earth, III. 6. Woodward, Eſs. Nat. Hist. of the Earth, p. 135—162, 220—225. Nat. Hist. &c. Illust. &c. Introd. p. 136, 140—143, 149—152. Whiston New Theor. &c. p. 78. 231, 334, 447. Gaſsend. Epicur. Philosoph. I. p. 546, &c.

nicest observations, that in the cave of the Observatory at Paris, only about ninety feet under ground, the heat keeps the thermometer at gr. 53, and that without any assistance from the sun; it being never sensibly increased by the most scorching seasons beyond its heat in the most severe winters that have been felt there. And the same constant and unalterable degree of heat was observed by Mr. Boyle* in a cave cut deep into the earth †. And great and even troublesome heats are said so be observed at greater depths and increasing in proportion to these depths; though I could wish these heats had been more regularly measured and ascertained than what I can find they have yet been. So that it would seem the body of the earth has a very great proper internal heat, independent on the sun, and very much beyond what he, without the intervention of our atmosphere could communicate to it; so great as, within 90 feet of its surface, to raise the thermometer 93 divisions above Fahrenheit's cold mixture, or

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* Mem. Hist. of the Air. Abr. III. p. 54.

† See Boyle Exp. on Cold, Abr. I. p. 641, 700, 701, 702. Boerh. Chem. I. p. 479. Woodw. Efs. Nat. Hist. of the Earth, p. 136.

453 divisions above what Mr. Amontons reckoned the lowest degree of heat. This heat of the earth at its surface is something leſs, and beyond that its force decreases indeed very fast, so as to leave the air at a small height above it a good deal colder; and which we find on the very high hills to be exceſsively cold, and not to be much warmed by the additional heat of the sun's direct rays, if they be but little altered by the earth's surface and atmosphere.

It is not our buſineſs so much as to attempt the explaining the cause and consequences of this innate heat. That is the work of those who have fire and fancy enough to build worlds, or theories of worlds. I will only beg leave to observe, after the Lord Verulam *, Mr. Boyle †, and others, that, the various temperatures of the air in different places of the earth, do by no means correspond to what should be the result of their position to the sun. To omit variations that are small and

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* Seq. Chart. p. 102.

† Exp. on Cold, Abr. I. p. 657—660, 670. Mem. Hist. of the Air, Abr. III. p. 52.

of leſs moment, I shall only take notice of the much greater cold in all the southern hemisphere than in the similarly situated places of the northern one; and of the greater colds in the North American countries, than in those of the same latitude on the European side of the globe. All which argues a copious fund of some other more potent cause of heat than the regular actions of the sun; and that that cause, inherent in the earth itself, is stronger in some regions of it than in others, though every where considerable and of great force.

The ingenious Dr. Halley* has a very bold hypothesis, which, beside other purposes, he employs in accounting for this anomaly of these warm and cold quarters of the world. He imagines that once the earth moved round an axis very different from the present, and so that "the extreme cold felt in some places, "as in the north-west of America, about "Hudson's Bay, may be occasioned by those "parts of the world having once been much "more northerly, or nearer the pole than now "they are, whereby there are immense quan

* Phil. Trans. Abr. VI. 2. p. 41.

" tities of ice yet unthawed in those parts, " which chill the air to that degree, that the " sun's warmth seems hardly to be felt there;" which, after some thousands of years, have not yet, it seems, acquired a sufficient heat: while by a parity of reason we may from the same principles infer, that the extraordinary soft temperature of some other places may be owing to their having originally been under or near the primitive equator, whereby they had acquired a heat which is not yet quite dissipated.

But, besides that in such an hypothesis those places should constantly be coming nearer and nearer to a regularity and uniformity with other countries alike in latitude, and other ordinary circumstances, the heat of bodies is so transient and fleeting, and the influence of the sun reaches so little way into the body of the earth, that I cannot conceive, even allowing the supposition of a changed axis, that the various degrees of the original primitive heats of the earth, communicated to it by the sun, could possibly have been so permanent and lasting, as to show themselves so effectually at this day: so that, as I said before, such a variety of heats must rather be owing to an

internal cause operating more intensely in some regions than in others, and every where much more strongly than any influence the sun can give them.

And if this be the case of the rest of the planets as well as of our earth, their heats, or the heats of bodies on their surfaces, will not solely nor even chiefly depend on the action of the sun on them, (as the philosophical astronomers* seem by their manner of speaking to suppose), those proper innate heats having a greater share in them than that external addition. Though this, however, may be neceſsary to support and preserve those entire; seeing all warm bodies, that are not endowed with a vital principle of heat, are, of their own accord, liable to a constant waste and decay of this quality.

But whatever be in this, from these considerations, the heat of the sun, and the heats

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* See Newton Princip. p. 405, 406, 508, 509, Gregor. Elem. Astron. VI. Prop. 2, 3, 4, 5, 6. Whist. Præl. Math. p. 327, 328. New Theor. &c. p. 53, 78. Hugen. Cosmotheor. II. p. 694, &c. Derham Physico Theol. p. 171—178.

of bodies approaching near him, will not be found so exorbitant as we have been accustomed to reckon them*. The proper or innate heats of the planets may be such that the inner ones are in no hazard of being too much scorched, nor the far-off ones of having too small an allowance of the benign influence of the sun's heat; and that, especially by the help of peculiarly disposed atmospheres concurring that way, there may be a great uniformity, in this respect, of the whole solar system. Even the comets themselves may, for any thing we know, be so constructed as to suffer no great inconvenience by their great eccentricities, and very variable distances from the central fire.

But where am I going? I find myself treading on slippery and enchanted ground. I fear I may be thought just now to have got too far into the bewitching and airy regions of fancy and conjecture, where I would not choose to dwell. However, at present having a delightful prospect in view, I would fain be indulged in one question before I quit this subject. What if, abstracting from the other solar influences of light, gravitation, &c.

* See Newton, ibid. p. 508. Whiston, ibid.

the great force and virtue of its additional heat on the bodies of planets (which is wisely contrived to be very variable and shifting) is to produce frequent changes on the otherwise equable heats of their surfaces, for the very great and noble purposes in the life and support of their inhabitants? as at least we know to be the state of our globe, which, by the viciſsitudes of night and day, winter and summer, and spring and autumn, beside other ends thereby accomplished, preserves in action and life both vegetables and animals, all which would stagnate and die in a state of heat always perfectly the same; for all natural organic bodies, from the lowest vegetable to those of the highest animal life, have, by the viciſsitudes of heat and cold they neceſsarily undergo, a constant oscillation, a perpetual alternate contraction and expansion of all their solid and fluid particles.

So then the sun, though it be not the sole or chief fountain, is, as it were, the great regulation of motion, heat, and life to the inhabitants of this system; and on this account the benefits, to us men, of this great mover, this awakener and enlivener of nature, are highly to be prized; which, however, were

much mistaken by the ancient heathen nations, and still continue to be so amongst many in the world, who having lost the true religion and philosophy of things, that were given to the first men, and so seeing things but by halves, and dazzled by the splendour of the sun's light and power, and sensible influences*, imagined, that for their life and all the goods thereof they depended on that great luminary, and so worshipped the creature instead of the Creator, the work, instead of him that made it, the knowledge of whom they had utterly lost. And this was never to be recovered without a new revelation, a new communication of himself from God to man, or a more accurate survey and knowledge of the system of nature than what mankind could of themselves soon or easily arrive at, by which the several connections, and subordinate dependencies of its parts one with another, and the great and universal dependence of the whole on a wise and omnipotent Maker and Ruler might be found out.—An inquiry indeed of the greatest concern to us men, and in which there have been very great steps made in these latter times, that do very much confirm and

* Wisdom of Solomon, xiii. 1—7.

illustrate the revelation given to Abraham for the conversation of the true religion, and continued to his posterity: which was afterwards much farther extended by the last grand revelation concerning the great Creator, the Lord of heaven and earth, that made the sun, earth, and stars, and governs them all with infinite wisdom and power.

IV. *Of the degrees of Heat in Animals.*

Thus much for the celestial and planetary heats. But now let us come nearer home, and consider the various degrees of heat in the living inhabitants of this our earth, which we can see, and feel, and examine by our senses; a very fruitful inquiry, and of greater immediate satisfaction and use to us, being what we are more particularly interested in.

The heat of animals is extremely various, both according to the variety of their kinds and the variety of the seasons. Zoologists have justly enough divided them into hot and cold, that is to say with respect to our senses. Those that are any thing near our own temperature we call hot, while all the others are reckoned cold, whose heat is much below ours,

and consequently affects our feeling with the sense of cold, though, according to what trials I have had opportunity of making, they are all, by their *vis vitæ*, kept something warmer than the medium in which they live.

The gradations of life from the warmest animals down to perfectly inert matter are very slow, and by very small and almost insensible degrees, seeing, as it is not easy to determine the lowest state of vegetation, so too the limits between the highest vegetables and the lowest animals are with difficulty to be distinguished. Now all bodies partake of the heat of the medium surrounding them, as air, water, or any thing else. Nor can I find by the most careful experiments purposely made, that vegetables, any more than the most inert and lifeleſs maſses of matter, are endowed with any vital heat beyond the temperature of the ambient air, to be distinguished by the nicest thermometers. As the air is a thin body, easily heated and cooled, so indeed when it is in a cooling state, as chiefly in the evenings and night season, it is colder than the plants in it. But on the other hand, for the same reason, through most part of the day it appears, and really becomes warm sooner and

more sensibly than they can do. But, when all are kept in an equable state, there is no difference of heat to be observed, the plants always corresponding exactly to the temperature of the ambient medium. "In vegetabili-"bus et plantis nullus reperitur caloris gradus "ad tactum, neque in lachrymis ipsorum, ne-"que in medullis recenter apertis *."

Nay the animals of low life have but very little additional heat beyond that of the air or water. The insect tribe greatly disappoint our expectations, seeming to be the most tender and delicate of all animals, and yet being those that can unhurt bear the greatest colds. They are preserved in the coldest seasons with little other shelter than the leaves and ragged barks of shrubs and trees, holes of the walls, or a very slight cover of earth; and some expose themselves quite naked and open †. Even in the bitter winters of $170\frac{5}{7}$ and $172\frac{5}{9}$ the insect eggs, nymphas, and aurelias, outlived the colds that were intolerable to the livelier animals: and we know how vastly low the fluid then subsided in the thermometers.

* Bacon Nov. Org. II. 12.

† Boerh. Chem. I. p. 287, 415.

Mr. de Reaumur* found some very young slender caterpillars that were able to bear a cold under gr. 4; and, what is still more, the French mathematicians in their Lapland journey in the autumn, were pestered with innumerable swarms of flies of various kinds †, whose eggs and aurelias must have wintered under still greater colds than this: and I find that caterpillars have but a small degree of heat, about a division or two above the air they live in.

The whole insect tribe is commonly brought under the clafs of cold animals ‡: on which account I cannot but take particular notice of a very singular exception in the heat of bees, a very remarkable branch of that genus of living creatures. As these, according to the curious observations of naturalists, have something very peculiar in their economy, fabric, and generation, so I have observed that they have a very singular constitution in the heat

* Mem. Ac. Sc. 1734, p. 257.

† Maupert. Fig. de la Terre, p. 12. See too Boyle Exp. of Cold, Abr. I. p 661.

‡ Vid. Bacon. Nov. Org. II. § 11. p. 167. § 12. p. 186. § 13. p. 192. Nat. Hist. 73. Leister de Bucc. p. 245.

of their bodies. This I have experienced frequently; and I find that the heat of a swarm of bees raises a thermometer buried amongst them above gr. 97; a degree of heat nothing inferior to our own.

The other animals of low life, agreeable to what I observed of the ordinary insects, have but very little additional heat above that of their supporting medium. I could scarcely distinguish any in muscles and oysters. It was very little in the branchial fishes. In flounders, whitings, codfish, and haddocks, the heat was found scarce a degree more than the salt water they were swimming in, even when that was so low as gr. 41. Nor are the red fishes much warmer than they. Some trouts, whose heat I examined, were but at gr. 62, when the river water they had been swimming in was at gr. 61*. Fish can live in water any thing warmer than freezing, that is, any thing above gr. 32.

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* And lately at Paris I found the heat of a carp scarcely to exceed gr. 54, the heat of the water wherein I examined it. The heat of an eel came out in the same way.

The result of several trials, made snails about 2 degrees warmer than the air. Frogs and land tortoises seemed to have the principle of heat something stronger, viz. about 5 degrees higher than the air they breathed in. Which I suppose to be the case of the ordinary breathing animals, who indeed have lungs (but these lungs of a wide vesicular form) and have their blood not a great deal warmer than the branchial fishes. Such I take to be the sea tortoises, toads, vipers, and all the serpent kind, who all have their lungs of the same fabric, and the same cold constitution of blood. But most of this sort of animals are not able to bear very great colds; they, in the severe seasons, retiring into lurking places, where they are tolerably well sheltered; often perhaps at about the middle temperature of gr. 48 or so. Their *vis vitæ* is indeed in those seasons very low*, and their waste of substance exceedingly small †. And I suppose the same may be said of the swallows, and other sleeping birds and beasts, who, though naturally warm ani-

* See Harv. de Mot. Cord. &c. IV. p. 28. XVII. p. 65. Leister de Cochl. p. 164. de Bucc. p. 246, 251.

† See Phil. Trans. Abr. II. p. 825. Leister de Cochl. p. 163, 165.

mals, much warmer than those already mentioned, are however in their inert state probably much colder than in their active and lively seasons.

For the heat of hot animals is not uniformly the same in all animals, and at all times. That admits of a very great latitude; it varies according to their various kinds and the circumstances of each. The surface of their bodies are, like other things, much affected by the heat or cold of the ambient medium, and consequently wrought upon by all the varieties of seasons and climates, if not sufficiently sheltered from their influences. When that is, their external and internal heat is nearly the same; but still differing something in different animals.

Dr. Boerhaave * indeed speaks of the heat of hot animals as in a natural state pretty uniform, or the same in all, reckoning it commonly to be such as to raise the mercury in the thermometer to gr. 92, or at most 94. And so, too, Dr. Pitcairn's† heat of the hu-

* Chem. I. p. 192, 207, 213, 414, 415, 526.

† El. Med. II. 1. § 26.

man skin at his gr. 17, falls near our gr. 92. Mr. Amontons* by several trials, found the heat communicated by the human body to his thermometer to be at dig. $58\frac{1}{12}$, $58\frac{5}{12}$, $58\frac{6}{12}$, $58\frac{7}{12}$, $58\frac{9}{12}$. These, by calculation, I find to fall about Fahrenheit's gr. 91, 92, and 93. Sir IsaacNewton's† gr. 12, which he makes equivalent to the external heat of the human body, and to the heat of a bird hatching eggs, comes to gr. $95\frac{1}{2}$ in ours. Fahrenheit himself‡ places his heat of the human body and blood at gr. 96. And at this mark Dr. Muſschenbroek‖ says, the thermometer stands, when it is immerged in the blood flowing from an animal; though in another** place he speaks of gr. 92 or 94, as a pretty high degree of heat for our blood.

I have very carefully made numberleſs observations on this subject of the heat of animals: and from them I must be allowed to say,

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* Mem. Ac. Sc. 1703. p. 235, 243.
† Phil. Trans. Abr. IV. 2. p. 1, 3.
‡ Ibid. p. 18, 52.
‖ Eph. Ultraj. 1728, p. 679.
** Eſs. de Phys. p. 502.

that I find all these reckonings much too general, and in the main considerably too low. I suspect that, at least in many of them, there was not sufficient time allowed to warm thoroughly the bulbs of their thermometers; or perhaps at the time of trial the folks hands had not the natural sheltered heat. The human kind is amongst the lowest of hot animals *: and yet I by the heat of my skin every way well sheltered, at a medium in an infinite number of trials, raise the mercury in the thermometer to about gr. 97 or 98. In some it goes a little higher, in others it keeps something lower. Urine new made, and that into a vessel of the same temperature with itself, is scarcely a degree hotter than the skin, as I have found by many repeated observations. And that heat of the urine we may reckon nearly equal to the heat of the neighbouring *viscera*. Dr. Hales † found the heat of his skin to be 54, and that of urine new made 58 degrees of his thermometer, which coincide with our gr. 99 and 103, if the calcul that was made of the correspondence of his thermometer with Fahrenheit's had been perfectly exact.

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* Cæsalp. Qu. Perip. V. 6. p. 132.

† Veg. Stat. p. 59.

In the mean time, as I just now said, the human kind is among the lowest of hot animals. Ordinary quadrupeds, as dogs, cats, sheep, oxen, swine, &c. by the heat of their skin raise the Thermometer 4 or 5 divisions higher than we, as to gr. 100, 101, 102, and some to 103 or a little more.

And the breathing or cetaceous fishes are as hot as they, as Dr. Boerhaave* very justly reckoned; though he ascribes too small a heat to them, and to all other respiring animals, when he confined it within the narrow bounds of 92 or 93 degrees. Those who have had occasion to travel into the East Indies† tell us, that the blood of the Manati Fish, or Sea Cow, was sensibly warm to the touch. And Mr. Richer‡, a curious enough observer of natural things, found the blood of the porpus as warm as the blood of land animals. I myself upon trial found the heat of the skin of that amphibious animal the sea

* Chem. I. p. 415.

† See Ent. Apolog. &c. p. 207. Le Comte Mem. de la Chine, II. p. 343.

‡ See Du Ham. Hist. Ac. Sc. p. m. 157. Mem. Ac. Sc. 1666—1668, VII. p. 325.

calf, to be near gr. 102. In the cavity of the *abdomen* it was about a division higher. In all this, as in many other respects, agreeing with our ordinary land quadrupeds; which, in the structure and form of their *viscera*, the breathing fishes do very much resemble.

The Lord Chancellor Bacon* gives it as a current opinion that the bird kind are very warm. They are indeed the warmest of all animals, warmer still than quadrupeds by 3 or 4 degrees, as I have found by experiments on ducks, geese, hens, pigeons, partridges, swallows, &c. The bulb end of the Thermometer being lodged in their groin, the mercury was raised to gr. 103, 104, 105, 106, 107; and in a hen hatching eggs I once found (for it is not always so high) the heat at gr. 108.

It was, I presume, without sufficient ground that the just now mentioned noble Lord† reckoned the external flesh of animals, when in action, to be hotter than their blood, &c. Generally in my experiments both on birds

* Nov. Org. II. 13. p. 193.

† Ibid.

and quadrupeds the *viscera* were found near a degree hotter than the skin; though sometimes I could perceive but little or no difference. And a Thermometer thrust into a fistulous ulcer running in amongst the muscles of the thigh in a man, showed a heat very little greater than that of the sheltered skin.

As the circulation is so very quick and free, the heat of the blood in the arteries and veins is pretty much the same, and but a small matter, it may be a degree or so, above the common heat of the bowels, or near two degrees warmer than the skin; a much smaller difference than what Sir Isaac Newton* and Dr. Hales† assign; according to whose reckonings that would be no less than 10 or 11 degrees.

V. *Of the preternatural Heats of Animals.*

These then are the heats of animals as in my experiments they generally appeared to me. But they are not to be held as universal.

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* Phil. Trans. Abr. IV. 2. p. 1. 2.

† Veg. Stat. p. 58. Hæmast. p. 98.

Beside the varieties in different individuals, the heat even in the same animals does not keep always the same. For ordinary indeed, and in health, the variations are not great; but by diseases and extraordinary accidents it may be much altered, and brought both above and below the natural standard. I cannot say that I have yet had opportunities of making observations enough to lay down any thing sufficient or satisfactory concerning the heat of animals in preternatural or morbid states. However, I think I may venture to say, that it is not so vastly great in fevers as some are apt to conjecture.

The medical writers all take notice of the constant and burning heats in ardent fevers. And we are told* of the Emperor Constantius and of some others, that they were of such a dry hot temperament, as, when heated by a fever, in some measure to burn the hands of those that touched them. But this burning heat no body then knew how to measure, or to preserve to us any distinct intelligible notion of it. The determining and affixing the due

* See Bacon, Nov. Org. II. 13. p. 192.

bounds to such things being reserved to this present age. The ingenious Dr. Hales* supposes the heat of the blood in high fevers to be about gr. 85 in his Thermometer, which comes to gr. 136½ in ours; a degree of heat which I believe no animal ever arrives at, nay, which I reckon no living creature is able to bear. Dr. Boerhaave † furnisheth us with some curious observations of animals very soon destroyed in air of gr. 146, who all died in leſs time than what would have been neceſsary to bring their bodies up to the heat of gr. 136. A Thermometer put into one of their mouths a little after its death stood at gr. 110.

Nor, on the other hand, would I suppose the fever heat so low, or that low heat so dangerous, as the great Dr. Boerhaave ‡ seems to do. He is afraid of its coagulating the *serum* of the blood, reckoning that terrible mischievous work might by effected by a degree of heat not much above gr. 100. Whence

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* Veg. Stat. p. 60.

† Chem. I. p. 275.

‡ Aph. 96, 689. Chem. I. p. 343. II. p. 352, 353, 378, 213, 357, 358.

Dr. Hales*, and Dr. Arbuthnot†, led thereto by Dr. Boerhaave's authority, affirm, that the natural heat of the blood of a human creature approaches very near the degree of coagulation. But I have seen fevers, and these not exceſsively violent neither, wherein I was aſsured, by observing the heat of the skin, that the blood was five or six degrees above gr. 100, without apprehending any such danger, or experiencing any such fatal effects‡. Such a heat, if neglected or wrong managed, may indeed, as Hippocrates‖ very justly observes, diſsipate the more thin and watery parts, and so gradually thickening the whole maſs of blood, have bad enough effects that way; if it do not bring on a putredinous thinneſs. But directly to coagulate the *serum* of blood, or the white of an egg, by several

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* Hæmast. p. 104. 105.

† Eſs. on Air, p. 114, 211.

‡ In the ague I had lately, during the height of the paroxysm, the heat of my skin was gr. 106; and so that of my blood gr. 107 or 108. And farther, what is very remarkable, in the beginning of the fit when I was all shivering, and under a great sense of cold, my skin was however two or three degrees warmer than in a natural healthy state.

‖ IV. De Morb. XXIII. 23, &c.

trials I found a heat requisite beyond any thing ever we can experience in a living animal. They continue thin and liquid till the thermometer points at gr. 156 or so. Which is an arithmetical mean betwixt the ordinary heat of human blood at gr. 99 or 100, and that of boiling water at gr. 212; exceeding the one just as much as it falls short of the other.

But no animal, I say, can bear a heat near this. Beside the bad effects it would have upon the fluid, I know our nerves are not able to endure such a scorching heat. If that be but a few degrees hotter than our blood, it comes to be intolerable *. Sir Isaac Newton † and Mr. Amontons ‡ felt water too hot for their hands stirring in it easily to bear at gr. 108. I suspect indeed the full heat of the water had not been thoroughly

* This excellent Essay was written in the year 1738, long before the experiments made by Sir Joseph Banks, Dr. Solander, and Dr. Fordyce, by which it appears, that the human body is capable of bearing an astonishing degree of heat. Phil. Tran. A. H.

† Phil. Trans. Abr. IV. 2. p. 2.

‡ Mem. Acad. Sc. 703. p. 236. 244.

communicated to their too bulky thermometers. I find it becomes scalding hot to my hands and feet at gr. 112 or 114. And so I reckon will most people find, who have not their organs too callous. We should not, however, judge of the delicacy of the body by the sensation of the hands, which in many folks by labour and use are rendered preternaturally insensible. Mr. Amontons's valet could bear water of the heat of gr. 122. And I have seen folks who could handle things freely, that I could not well touch. I doubt not but the hotter animals can likewise bear a greater heat than us. And, on the other side, fishes and cold animals may be scalded to death with a heat less than that of our blood. A perch, one of the most lively of the branchial fishes, died in three minutes in water heated but to gr. 96*.

At first, men often gave names to things from certain resemblances, without pretending thereby to understand or exhibit their natures. And in this view physicians may continue to talk of the το πυρ, the *febris ardens*, and *in-*

* Muſschen. Tent. Exp. Ac. Cim. Add. p 122.

flammations, and freely use these and other fiery names, if they mean no more by them (as it is likely they did not in the original use of them) than a figurative way of expreſsing extraordinary heats of the body, or the heat of the blood carried considerably beyond its natural state. But from undeniable experiments we see they must be much mistaken, who not confining themselves to the figurative use of these names, and led astray by vain and ill-grounded theories, talk of real scorchings of the body, and actual burnings of the heart and other *viscera*, of ebullitions and effervescences of the blood, of its being kindled and ready to burst into flame *, and of other such fiery descriptions of heats, which no animal, while in life, can be brought into. So that these are ways of speaking, which to prevent mistakes, should have no place out of poetry; where alone such bold figures, and these expreſsed in such a strong manner, without any restriction, are to be allowed. Thus some people by their profeſsion, may be permitted

> Jecur *to burn, and* Cor *to pierce,*
> *As either best supplies their verse* †.

* Willis Pharm. Rat. II. p. 22.

† Prior, Alma, p. 87.

But for others, who from the nature and great consequence of the subject they deal in should be more strictly tied to truth, gravely to talk of the liver burning up the bile, and speaking of the heart as they would of a piece of red-hot iron, burning the hands of those that touch it*, or boiling up into froth the blood that falls into it †; and others to give out the stomach as a kettle boiling our food by its great heat‡; such asſertions as these are unwarrantable impositions on the senses of mankind, and should be dropt by all sober thinking men.

We see then that nature seldom carries the body or blood of animals to a degree of heat very much beyond its ordinary healthy temperature. Nor indeed are we able to bear any very great exceſs of that kind, either in the

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* Abu. Jaafar Ebn. Tophail. Philos. Autodid. p. 64. Ali Rodoan apud Gom. Pereir. Antonian. Marg. p. 326, 770, Columb. de Re Anat. XIV. p. m. 477. 481. Diemerb. Anat. II. 6.

† Des Cartes de Meth. 5. p. 29. De Hom. p. 8. De Form. Fœt. § 18, 72. De Paſs. I. 8, 9. Epist. I. 52.

‡ Hipp. apud Celſ. Med. Præf. p. 6. Stukely of the Spleen, p. 35.

body itself, or in the medium without us. We can, however, on the other hand, endure greater excesses of cold, at least externally affecting us; there being many remarkable instances of the surface and extremities undergoing very great colds without being absolutely destroyed. We have all, I suppose, some time or other, even here, experienced very sharp nipping colds. These, however, are nothing, compared to the frightful accounts we have had of the great prevalency of cold on the bodies of men and other animals in the more northern countries. Often are they quite frozen to death; but, at other times, though the cold has gone a great length, they are happily recovered. We have been told* of animals found stiff cold in their lurking places, or buried in lumps of ice, that, by the *stimulus* of pain, or a warmer air, have been again brought to their life and senses. Partial freezings of the nose, hands, feet, &c. of the human body are frequent. But, what is much more, there are instances† of men being so frozen by the lump, that when plunged into

* Boyle Exp. on Cold, Abr. I. p. 671, 673. Quesnay Œcon. Anim. p. 25.

† Fabr. Hild. de Gang. &c. XIII. p. 792.

cold water they contracted a cover of ice over their whole body, which therefore in all its exterior parts must have had a cold considerably under gr. 32. If it came so low as gr. 25, the blood must have been frozen in some of its veſsels. However, even in this terrible threatening state, when the whole body seemed to run such a risk of congelation and the sleep of death, by good management, well understood in these intemperate countries, people have been brought to life again. In such extreme cases one would think that the internal heat too must have been considerably impaired; but how low that may be carried without danger or immediate death, we cannot yet determine. In the mean time, the measuring the heat of the birds and beasts that paſs the winter in a state of sleep and insensibility, might give us some light into this matter *.

* This very excellent treatise was written in the year 1738. A. H.

ESSAY II.

On Inland Navigations and Public Roads.

IN this country, the commerce and agriculture of which has derived such important benefit from the extensive means already effected, of giving facility to the conveyance of the various products of the island, from parts where they were useleſs, to others where they are valuable; it is an inquiry highly interesting, whether it may not be an object deserving the attention of the legislature, to promote a more general extension of those benefits, by a general survey of the kingdom, with this object particularly in view.

Water is brought to us without expense of carriage, and is one of the many bleſsings showered down upon us, the sources of which are inexhaustible. The parts of which, though yielding to the least power, yet are capable of supporting immense weight, but are not like the materials with which roads are con-

structed, liable to great wear; and a canal once made, is not liable to much repair.

About four acres of land are cut up for the length of one mile of canal; but this land so cut is not yet lost, but may become a pasture for fish, and equally valuable as in its former state; and one horse on a canal is capable of performing the work of fifty horses upon a road.

The length of canals in the kingdom, when the whole under prosecution at present are completed, will be about 1000 miles. The sea-line of England, Scotland, and Ireland, and the adjacent islands, is about three thousand eight hundred miles in length.

Imperfect as our present maps are, they give tolerable information of the relative situation of roads and rivers, and of the distance of places from each other; but they convey no adequate ideas of the respective heights or depreſsions of the surface.

Taking the mean between the high and low water of a neap-tide as the level of the sea; if level lines were traced round the

island at equal heights above each other (for intance twenty feet), and those lines were surveyed and laid down on a map as zones, you might, by counting those lines, ascertain within a few feet the height of any given point above the level of the sea; as promontories on the sea-coast, where many of them would meet, their height would be shown; in the vallies, where those lines would diverge from each other, you would ascertain the falls of the rivers within given distances; above the general surface of the country the lines would define the shape of the higher grounds, and mountains; where they would crofs public roads, stones might be fixed (which on local surveys might be referred to), ascertaining by figures thereon, the height of those points above the level of the sea, or above or below similar points in other situations; they might be of some use also on being referred to in meteorological observations.

In the surveying of those lines, they might, by intersection, mark the situation of towns, villages, and remarkable points, and thereby would much contribute to the obtaining a correct map of the country.

The conduct of this business might be intrusted to an able surveyor, who should have under his direction ten or twelve sets of surveyors and levellers; one surveyor one leveller in each set, with three or four labourers as assistants; active young men, who might be fully competent to the execution of their part of the business, might be engaged at little expense; their observations would be compared and corrected by their principal; and by setting out together, they would correct and check each other, when in prominent parts of the country they would be near each other.

With such a map before us, we might generally ascertain the practicability of making water communications from one part of the country to another; whether they might be conducted on one level, or what rise and fall must be encountered: from hence, assisted by a mineral survey, and by the various information which will be obtained, we might draw the outlines of a general system, which would stand upon record, to be referred to when any local project may be brought forward.

While the zones in the map of the island would be complete but on a small scale, the parts of those zones appropriate to the county maps or other subdivisions, would, on a larger scale, be more accurately defined.

In the year 1792 I had occasion to make some observations on the subject of collecting and preserving flood waters by means of reservoirs; and I understand those observations have been referred to in the Report from Staffordshire.

Where proper situations may be found on waste lands, the appropriation of such lands to this use will hardly be objected to*; but it might be a question, whether the loſs of more valuable land would be compensated by the benefits which other land would derive from it by irrigation; I believe those conversant in this practice would resolve it in the affirmative: but in conversation with a gentleman eminently distinguished by his improvement of the breed of live-stock, he has

* If such a survey were undertaken, the surveyors might take notice of proper places for making reservoirs.

denied the position, that land is lost by being covered with water; and he is of opinion, that an acre of water well managed in breeding or feeding of fish, would produce more food for the use of man, than an acre of the best land under the best management; in corroboration of this opinion, I have been informed that a farmer in the neighbourhood of Wolverhampton, from an acre and a half of water, has for several years succeſsively sold his fish in the market of Wolverhampton for more than twelve pounds per annum.

It is certain that little or no systematic attention has been given to inland fisheries; it is at least a matter worthy of investigation, and deserving of attention.

It may be objected, that reservoirs from which the water will be drawn off in summer, will be ineligible for fish. But it is neceſsary to be understood, that those reservoirs will generally be made by a high embankment or head acroſs a valley; that the earth for making such head will be dug out of the bottom of the valley, within the reservoir; that a reservoir from thirty to sixty acres will generally require a head from twenty to thirty

feet in height; that when two-thirds of the depth is drawn off, there may remain from five to ten acres of water, which will contain but a small quantity of water for irrigation, but be amply sufficient to maintain the fish for a month or two, until it may be replenished by autumnal rain.

While the water is gradually drawn off, the desiccated borders of the reservoir may be ploughed, and sown with some vegetable; which may serve as food for the fish in winter, or as a nidus for the ova of insects, on which the fish may feed.

It may next be a question worth consideration, how far navigable canals may serve in some cases in aid of irrigation, as principal conductors of the water from reservoirs.

Many miles of canals are cut on sloping grounds, and are well adapted to discharge water over lands which lie below their level; in wet seasons they have generally a superabundance of water, which might be conveniently spared, while reservoirs are collecting water for the summer; in dry seasons few have water to spare, and any interference with

them might create jealousy and distrust. In canals which may be hereafter projected, and especially if subjected to systematic regulation, terms of compact may be easily adjusted between land-owners and undertakers of canals, while bills are pending in parliament. With those already obtained, it may not be so easy to treat; but it is certainly practicable when water is discharged from a reservoir into a canal, to ascertain the quantity so discharged: it is also practicable to lay pipes through the banks of the canal, which shall discharge an equal quantity, and if the time of running out corresponds with the time of running in, no disadvantage can result to the navigation.

While canal navigations are avowedly safe, easy, and certain, except in times of frost, I cannot agree with those who maintain, that they are in all cases preferable to river navigations: there is no rule without exception; there are numberless instances where river navigations are preferable to canals; first, because they are generally effected at the least expense; and secondly, because when obstructions are removed and avoided, they are susceptible of more expedition; except in the

few weeks in a year where they are annoyed by floods; for being leſs encumbered with bridges, and having generally a greater width, veſsels are enabled to make use of sails; and at such times the labour of horses is saved. On the river Trent, which, compared with some others, is very imperfect, goods are conveyed seventy miles for eight shillings per ton, including freight, tonnage, risk, and profit of the boat-owners; there are but few canal navigations on which the expense of conveyance is not half as much more; and I consider the expense of conveyance as the chief criterion. In point of expedition, veſsels frequently make a voyage of seventy miles, and back again in a week, including the time of lading and unlading; this has been done by the same veſsel for ten weeks succeſsively; and would often be done if they were not obliged to wait for their lading.

Next to inland navigation, public roads, and the carriages used on them, are highly deserving of public attention. I do not know any thing in this country (where mechanism in general has been patronized, and brought nearer to perfection than in most others) that has been more neglected than the proper con-

struction of wheel-carriages, and the formation of roads.

It has been generally acknowledged, that for carriages of burden, broad wheels, which will roll the roads, are the most eligible; and by the exemptions which have been granted to those who use broad wheels, the legislature has certainly looked forward to the benefits to be expected from the use of them; but never was a proposition more misunderstood, or an indulgence more abused. Of all the barbarous and abominable machines that have been contrived by ignorance, and maintained by vulgar prejudice, none have equalled the broad-wheeled carriages that are now in use; instead of rolling the roads, they grind them into mud and dust.

Wheels compelled to move forward in right lines cannot roll a road, unleſs they are cylindrical; this was never stipulated by the legislature; they only required that the wheels should tread flat on the road, a given number of inches in width.

The wheel-wright, to give more strength to the wheel, to make the axis as short as

poſsible, and to give more room above for the body of the carriage, dished his wheels (to use their phrase,) at the same time making the sole flat; but instead of the sole or rim being cylindrical, it was a portion of a cone, the property of which, if it were to roll, would be to revolve in a circle; in a circle it could not revolve, unleſs set at liberty from the carriage, and then the wheels would leave each other, take a short turn, and come back again. Thus forced against their inclination to move parallel to each other in right lines, with an immense weight on them, having a little liberty on the arm or axis, they partly rolled and partly were dragged; this was found so laborious to the horses, that the next effort of their ingenuity was, in the first place to make the sole convex, and next to make the middle rim of the tire or iron which binds the wheel, half an inch thicker than those on each side of it: by this means, with all the expense and encumbrance of broad and heavy wheels, they are completely converted into narrow ones. But they are much more mischievous than narrow ones, because they are suffered to carry immense loads, and from their exemptions from toll, do not contribute to the repair of the roads half so much as

narrow-wheeled carriages, which do far lefs injury. On a hard road, where only the narrow rim has a bearing, they crush the materials; on a soft road, where by sinking, the whole surface comes into contact, they grind the materials into mud and dust, at a great expense of horse flesh.

If you remonstrate with the wheel-wright he will tell you, that if the wheel treads flat on the ground, as there is only one point at a time of the circumference that touches the ground, it is immaterial what the position of the remainder of the wheel is in, which is moving in the air: if you tell him to make a garden-roller in the form of a sugar loaf, he will find that though only one point, or rather line of the circumference touches the ground, while the remainder is moving in the air, it will, if moved at ease, revolve in a circle; and to move it in a right line, it must with difficulty be dragged; and if you cut off a frustum of it, it will still move in the same circle; he cannot deny it, but still he is not convinced.

Public roads will never be maintained in repair as they ought to be, until the legislature

compel the use of cylindrical broad wheels; if once got into general use the roads will become smooth, and free from obstacles; when obstacles are removed, there is then an opening for further improvement; the wheels may be made one-half lefs in height, and consequently in weight. There will be a little more friction on the axis, but this is a trifling consideration, compared with the evils which I have described; the roads will be maintained at half the expense, and travelling carriages will move with ease and expedition.

In the formation of roads two things of material importance are unattended to; the one where roads are repaired with stone, is the neglect of breaking the stones, which ought to be left not larger than walnuts; I was ashamed for my country, when I saw this minutely attended to in a wild part of the north-west of Ireland: the other, which is still more important, the use of water on roads in wet seasons; on roads buried in mud, if accident turns on to them a little stream of water, such parts of the road are always the best. I must request of gentlemen who travel, to give some attention to this circumstance: on the turnpike roads numbers of

men are employed in scraping off the dirt, and with it they scrape off much of the good material; carriages are afterwards employed at a considerable expense to carry it off.

There are few situations where in rainy seasons water may not be collected from the ditches of adjoining lands, and be dammed up and turned on to the roads: this, by the aſsistance of one-third of the labourers that are usually employed, will effectually do more buſineſs than the whole of them in scraping; by washing away the fluid mud, and leaving the gravelly particles in the ruts, on the return of dry weather, if the water is turned off into the ditches, the road will dry more in one day, than with the mud on it will dry in a week.

Some miles of the road between Leicester and Northampton is managed in this way, though not so well managed as it might be; there are a few other instances of this practice, but none of them perfect. In the neighbourhood of Daventry their materials are so bad, that the roads would sometimes be impaſsable without the use of water; and they

have from neceſsity erected pumps to raise the water where they have no other means of getting it.

In the late wet season, the road between London and Uxbridge, with the best materials in the world to make it, was almost impaſsable, while streamlets of water were running in the ditches, which in a few days, if they had been made use of, would have made it as good as any road in the kingdom.

ESSAY III.

On Natural History as applied to the proof of an intelligent Creator.

IN all cases, wherein the mind feels itself in danger of being confounded by variety, it is sure to rest upon a few strong points, or perhaps upon a single instance. Amongst a multitude of proofs, it is one that does the buſineſs. If we observe in any argument, that hardly two minds fix upon the same instance, the diversity of choice shows the strength

of the argument, because it shows the number and competition of the examples. There is no subject in which the tendency to dwell upon select or single topics is so usual, because there is no subject, of which, in its full extent, the latitude is so great, as that of natural history applied to the proof of an intelligent Creator. For my part, I take my stand in human anatomy: and the examples of mechanism I should be apt to draw out from the copious catalogue which it supplies, are the pivot upon which the head turns, the ligament within the socket of the hip joint, the pulley or trochlear muscle of the eye, the epiglottis, the bandages which tie down the tendons of the wrist and instep, the slit or perforated muscles at the hands and feet, the knitting of the intestines to the mesentery, the course of the chyle into the blood, and the constitution of the sexes as extended throughous the whole of the animal creation. Of these instances, there is not one of the number which I do not think decisive; not one which is not strictly mechanical: nor have I read or heard of any solution of these appearances, which, in the smallest degree, shakes the conclusion that we build upon them.

But of the greatest part of those who read arguments to prove the existence of a God, it will be said, that they leave off only where they began; that they were never ignorant of this great truth, never doubted of it; that it does not therefore appear, what is gained by researches from which no new opinion is learnt, and upon the subject of which no proofs were wanted. Now I answer, that, by investigation, the following points are always gained, in favour of doctrines even the most generally acknowledged, (supposing them to be true,) viz. stability and impreſsion. Occasions will arise to try the firmneſs of our most habitual opinions. And, upon these occasions, it is a matter of incalculable use to feel our foundation; to find a support in argument for what we had taken up upon authority. In the present case, the arguments upon which the conclusion rests, are exactly such as a truth of universal concern ought to rest upon. "They are sufficiently open to the views and capacities of the unlearned, at the same time that they acquire new strength and lustre from the discoveries of the learned." If they had been altogether abstruse and recondite, they would not have found their way to the understandings of the

maſs of mankind; if they had been merely popular, they might have wanted solidity.

But, secondly, what is gained by research in the stability of our conclusion, is also gained from it in impreſsion. Physicians tell us, that there is a great deal of difference between taking a medicine, and the medicine getting into the constitution. A difference not unlike which, obtains with respect to those great moral propositions, which ought to form the directing principles of human conduct. It is one thing to aſsent to a proposition of this sort; another, and a very different thing, to have properly imbibed its influence. I take the case to be this: perhaps almost every man living has a particular train of thought, into which his mind falls, when at leisure from the impreſsions and ideas that occasionally excite it: perhaps, also, the train of thought here spoken of, more than any other thing, determines the character. It is of the utmost consequence, therefore, that this property of our constitution be well regulated. Now it is by frequent or continued meditation upon a subject, by placing a subject in different points of view, by induction of particulars, by variety of examples, by applying

principles to the solution of phænomena, by dwelling upon proofs and consequences, that mental exercise is drawn into any particular channel. It is by these means, at least, that we have any power over it. The train of spontaneous thought, and the choice of that train, may be directed to different ends, and may appear to be more or less judiciously fixed, according to the purpose in respect of which we consider it: but, in a moral view, I shall not, I believe, be contradicted when I say, that, if one train of thinking be more desirable than another, it is that which regards the phænomena of nature with a constant reference to a supreme intelligent Author. To have made this the ruling, the habitual sentiment of our minds, is to have laid the foundation of every thing which is religious. The world from thenceforth becomes a temple, and life itself one continued act of adoration. The change is no less than this, that, whereas formerly God was seldom in our thoughts, we can now scarcely look upon any thing without perceiving its relation to him. Every organized natural body, in the provisions which it contains for its sustentation and propagation, testifies a care on the part of the Creator expressly directed to these purposes.

We are on all sides surrounded by such bodies; examined in their parts, wonderfully curious; compared with one another, no leſs wonderfully diversified. So that the mind, as well as the eye, may either expatiate in variety and multitude, or fix itself down to the investigation of particular divisions of the science. And in either case, it will rise up from its occupation, poſseſsed by the subject, in a very different manner, and with a very different degree of influence, from what a mere aſsent to any verbal proposition which can be formed concerning the existence of the Deity, at least that merely complying aſsent with which those about us are satisfied, and with which we are too apt to satisfy ourselves, will or can produce upon the thoughts. More especially may this difference be perceived, in the degree of admiration and of awe, with which the Divinity is regarded, when represented to the understanding by its own remarks, its own reflections, and its own reasonings compared with what is excited by any language that can be used by others. The works of nature want only to be contemplated. When contemplated, they have every thing in them which can astonish by their greatneſs: for, of the vast scale of operation through which our

discoveries carry us, at one end we see an intelligent Power arranging planetary systems, fixing, for instance, the trajectory of Saturn, or constructing a ring of a hundred thousand miles diameter, to surround his body, and be suspended like a magnificent arch over the heads of his inhabitants; and, at the other, bending a hooked tooth, concerting and providing an appropriate mechanism, for the clasping and reclasping of the filaments of the feather of a humming bird. We have proof, not only of both these works proceeding from an intelligent agent, but of their proceeding from the same agent: for, in the first place, we can trace an identity of plan, a connection of system, from Saturn to our own globe; and when arrived upon our globe, we can, in the second place, pursue the connection through all the organized, especially the animated, bodies which it supports. We can observe marks of a common relation, as well to one another, as to the elements of which their habitation is composed. Therefore one mind hath planned, or at least hath prescribed a general plan, for all these productions. One Being has been concerned in all.

Under this stupendous Being we live. Our happineſs, our existence, is in his hands. All we expect must come from him. Nor ought we to feel our situation insecure. In every nature, and in every portion of nature which we can descry, we find attention bestowed upon even the minutest parts. The hinges in the wings of an earwig, and the joints of its antennæ, are as highly wrought as if the Creator had had nothing else to finish. We see no signs of diminution of care by multiplicity of objects, or of distraction of thought by variety. We have no reason to fear, therefore, our being forgotten, or overlooked, or neglected.

The existence and character of the Deity, is, in every view, the most interesting of all human speculations. In none, however, is it more so, than as it facilitates the belief of the fundamental articles of Revelation. It is a step to have it proved, that there must be something in the world more than what we see. It is a further step to know, that, amongst the invisible things of nature, there must be an intelligent mind, concerned in its production, order, and support. These points being aſsured to us by Natural Theology, we

may well leave to Revelation the disclosure of many particulars, which our researches cannot reach, respecting either the nature of this Being as the original cause of all things, or his character and designs as a moral governor; and not only so, but the more full confirmation of other particulars, of which, though they do not lie altogether beyond our reasonings and our probabilities, the certainty is by no means equal to the importance. The true Theist will be the first to listen to any credible communication of divine knowledge. Nothing which he has learnt from Natural Theology will diminish his desire of further instruction, or his disposition to receive it with humility and thankfulness. He wishes for light: he rejoices in light. His inward veneration of this great Being, will incline him to attend with the utmost seriousness, not only to all that can be discovered concerning him by researches into nature, but to all that is taught by a revelation, which gives reasonable proof of having proceeded from him.

But, above every other article of revealed religion, does the anterior belief of a Deity, bear with the strongest force, upon that grand point, which gives indeed interest and im-

portance to all the rest—the resurrection of the human dead. The thing might appear hopeleſs, did we not see a power at work adequate to the effect; a power under the guidance of an intelligent will, and a power penetrating the inmost receſses of all substance. I am far from justifying the opinion of those, who "thought it a thing incredible that God should raise the dead;" but I admit that it is first neceſsary to be persuaded that there is a God to do so. This being thoroughly settled in our minds, there seems to be nothing in this proceſs (concealed and mysterious as we confeſs it to be) which need to shock our belief. They who have taken up the opinion, that the acts of the human mind depend upon organization, that the mind itself indeed consists in organization, are supposed to find a greater difficulty than others do, in admitting a transition by death to a new state of sentient existence, because the old organization is apparently diſsolved. But I do not see that any impracticability need be apprehended even by these; or that the change, even upon their hypothesis, is far removed from the analogy of some other operations, which we know with certainty that the Deity is carrying on. In the ordinary derivation of plants and animals

from one another, a particle, in many cases, minuter than all aſsignable, all conceivable dimension; an aura, an effluvium, an infinitesimal; determines the organization of a future body: does no leſs than fix, whether that which is about to be produced, shall be a vegetable, a merely sentient, or a rational being; an oak, a frog, or a philosopher; makes all these differences; gives to the future body its qualities, and nature, and species. And this particle, from which springs, and by which is determined a whole future nature, itself proceeds from, and owes its constitution to, a prior body: nevertheleſs, which is seen in plants most decisively, the incepted organization, though formed within, and through, and by a preceding organization, is not corrupted by its corruption, or destroyed by its diſsolution; but, on the contrary, is sometimes extricated and developed by those very causes; survives and comes into action, when the purpose for which it was prepared, requires its use. Now an economy which nature has adopted, when the purpose was to transfer an organization from one individual to another, may have something analogous to it, when the purpose is to transmit an organization from one state of being to another state: and they

who found thought in organization, may see something in this analogy applicable to their difficulties; for, whatever can transmit a similarity of organization will answer their purpose, because, according even to their own theory, it may be the vehicle of consciousnefs, and because consciousnefs carries identity and individuality along with it through all changes of form or of visible qualities. In the most general case, that, as we have said, of the derivation of plants and animals from one another, the latent organization is either itself similar to the old organization, or has the power of communicating to new matter the old organic form. But it is not restricted to this rule. There are other cases, especially in the progrefs of insect life, in which the dormant organization does not much resemble that which incloses it, and still lefs suits with the situation in which the inclosing body is placed, but suits with a different situation to which it is destined. In the larva of the libellula, which lives constantly, and has still long to live, under water, are descried the wings of a fly, which two years afterwards is to mount into the air. Is there nothing in this analogy? It serves at least to show, that, even in the observable course of nature, organi-

zations are formed one beneath another; and, amongst a thousand other instances, it shows completely, that the Deity can mold and fashion the parts of material nature, so as to fulfil any purpose whatever which he pleased to appoint.

They who refer the operations of mind to a substance totally and eſsentially different from matter, (as most certainly these operations, though affected by material causes, hold very little affinity to any properties of matter with which we are acquainted,) adopt, perhaps a juster reasoning and a better philosophy; and by these the considerations above suggested are not wanted, at least in the same degree. But to such as find, which some persons do find, an insuperable difficulty in shaking off an adherence to those analogies, which the corporeal world is continually suggesting to their thoughts; to such, I say, every consideration will be a relief, which manifests the extent of that intelligent power which is acting in nature, the fruitfulneſs of its resources, the variety, and aptneſs, and succeſs of its means; most especially every consideration, which tends to show, that, in the translation of a conscious existence, there is

not, even in their own way of regarding it, any thing greatly beyond, or totally unlike, what takes place in such parts (probably small parts) of the order of nature, as are acceſsible to our observation.

Again; if there be those who think, that the contractedneſs and debility of the human faculties in our present state, seem ill to accord with the high destinies which the expectations of religion point out to us, I would only ask them, whether any one, who saw a child two hours after its birth, could suppose that it would ever come to understand *fluxions** ; or who then shall say, what further amplification of intellectual powers, what acceſsion of knowledge, what advance and improvement, the rational faculty, be its constitution what it will, may not admit of, when placed amidst new objects, and endowed with a sensorium, adapted, as it undoubtedly will be, and as our present senses are, to the perception of those substances, and of those properties of things, with which our concern may lie.

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* See Search's Light of Nature, paſsim.

Upon the whole; in every thing which respects this awful, but, as we trust, glorious change, we have a wise and powerful Being, (the Author, in nature, of infinitely various expedients for infinitely various ends,) upon whom to rely for the choice and appointment of means, adequate to the execution of any plan which his goodneſs or his justice may have formed, for the moral and accountable part of his terrestrial creation. That great office rests with Him: be it ours to hope and to prepare, under a firm and settled persuasion, that, living and dying, we are his; that life is paſsed in his constant presence; that death resigns us to his merciful disposal.

ESSAY IV.

On Extreme-Branch Grafting.

FROM much conversation with Mr. Bucknall on the idea of improving standard fruit-trees, I could not but remark that in apple orchards, even in such as are most valuable, some were to be seen that were stinted and barren, which not only occasioned a loſs in the production, but made a break in the rows, and spoiled the beauty and uniformity of the plantation.

To bring these trees into an equal state of bearing, size, and appearance, in a short time, is an object of the greatest importance in the system of orcharding, and also for the recovery of old barren trees, which are fallen into decay, not so much from age, as from the sorts of their fruits being of the worn-out and deemed nearly lost varieties.

Having long entertained these thoughts, and been by no means inattentive to the accomplishment of the design, I attempted to change their fruits by a new mode of en-

grafting, and am bold enough to asfert, that I have most fortunately succeeded in my experiments; working, if I am to be allowed to say it, from the errors of other practitioners, as also from those of my own habits.

Under these impreſsions, and having many trees of this description, I made an experiment on three of them in March, 1798, each being nearly a hundred years old. They were not decayed in their bodies, and but little in their branches. Two of these were golden pippins, and the other was a golden rennet. Each likewise had been past a bearing state for several years. I also followed up the practice on many more the succeeding spring, and that of the last year, to the number of forty at least, in my different plantations*.

I directed the proceſs to be conducted as follows: Cut out all the spray wood, and make the tree a perfect skeleton, leaving all the healthy limbs; then clean the branches, and cut the top of each branch off where it would measure in circumference from the size of a shilling to about that of a crown piece. Some of the branches must of course

* The average expense I calculated at 2s. 6d each tree.

be taken off where it is a little larger, and some smaller, to preserve the canopy or head of the tree; and it will be neceſsary to take out the branches which croſs others, and observe the arms are left to fork off, so that no considerable opening is to be perceived when you stand under the tree, but that they may represent an uniform head. I must here remark to the practitioner, when he is preparing the tree as I directed, that he should leave the branches sufficiently long to allow of two or three inches to be taken off by the saw, that all the splintered parts may be removed.

The trees being thus prepared, put in one or two grafts at the extremity of each branch; and from this circumstance I wish to have the method called *Extreme-Branch Grafting*.

A Cement, described at the end of this Eſsay, must be used instead of clay, and the grafts tied with baſs or soft strings. As there was a considerable quantity of moſs on the bodies and branches of the trees, I ordered my gardener to scrape it off, which is effectually done when they are in a wet state by a stubbed birch broom, I then ordered

him to brush them over with coarse oil, which invigorated the growth of the tree, acted as a manure to the bark, and made it expand very evidently; the old cracks were soon, by this operation, rendered invisible.

All wounds should be perfectly cleaned out, and Mr. Bucknall's Medication applied as described at the end of this Eſsay. By the beginning of July, the bandages were cut, and the shoots from the grafts shortened, to prevent them from blowing out. I must here, too, obserye, that all the shoots or suckers from the tree must enjoy the full liberty of growth, till the succeeding spring, when the greater part must be taken out, and few but the grafts suffered to remain, except on a branch where the grafts have not taken: in that case, leave one or more of the suckers, which will take a graft the second year, and make good the deficiency. This was the whole of the proceſs*.

By observing what is here stated, it will

* The system succeeds equally well on pear, as also on cherry trees, provided the medication is used to prevent the cherry tree from gumming.

appear that the tree remains nearly as large when the operation is finished, as it was before the buſineſs was undertaken; and this is a moſt eſſential circumſtance, as no part of the former vegetation is loſt, which is in health fit to continue for forming the new tree.

It is worthy of notice, that when the vivifying rays of the ſun have caused the ſap to flow, these grafts inducing the fluid through the pores to every part of the tree, will occaſion innumerable ſuckers or ſcions to ſtart through the bark, which, together with the grafts, give ſuch energy to vegetation, that in the courſe of the ſummer the tree will be actually covered over by a thick foliage, which enforces and quickens the due circulation of ſap. These, when combined, fully compel the roots to work for the general benefit of the tree.

In these experiments I judged it proper to make choice of grafts from the ſorts of fruits which were the moſt luxuriant in their growth, or any new variety; by which means a greater vigour was excited: and if this obſervation is attended to, the practitioner will clearly perceive, from the firſt year's growth, that the

grafts would soon starve the suckers which shoot forth below them, if they were suffered to remain*. With a view to accomplish this grand object of improvement, I gave much attention, as I have before observed, to the general practice of invigorating old trees; and I happily discovered the error of the common mode of engrafting but a short distance from the trunk or body. There the circumference of the wounds is as large as to require several grafts, which cannot firmly unite and clasp over the stumps, and consequently these wounds lay a foundation for after-decay. If that were not the case, yet it so reduces the size of the tree, that it could not recover its former state in many years; and it is dubious if it ever would: whereas, by my method of extreme grafting, the tree will be larger in three or four years, than before the operation was performed. For all the large branches remaining, the tree has nothing to make but fruit-bearing wood; and from the beautiful verdure it soon acquires,

* This thought should be kept in suspense, as ten years hence it may appear otherwise. However, they will be valuable trees, and highly profitable, as will any other brought under the same system.

and the symmetry of the tree, no argument is neceſsary to enforce the practice.

From trees engrafted upon my plan, I had last season, about two bushels of the finest fruit I had in my orchard, from each tree, and from the third summer's wood only. Some engrafted from Ribston pippins were beautiful.

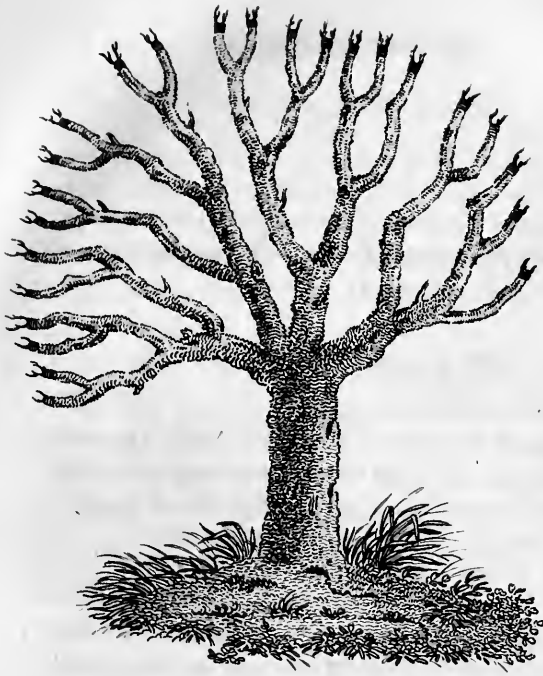
Mr. Bucknall visited me this summer for the expreſs purpose of seeing my trees; and he says the manner of conducting the system is the happiest that ever was conceived. For when a tree has done its best, and has continued to extreme old age, just disposed to fall into diſsolution, as also when this is the case with trees in a stagnated and barren state, they are thus renovated, and may, with the greatest probability, continue valuable for fifty years to come. I need not say, do not make the attempt when the energy of growth is over; that will easily be seen by the body and arms, but more particularly from the size, figure, shape, and colour of the leaves, which give the proper indication of health or decay in vegetation.

Cement for Engrafting.

Take one pound of pitch, one pound of rosin, half a pound of bees-wax, a quarter of a pound of hogslard, and a quarter of a pound of turpentine; to be boiled up together, but not to be used till you can bear your finger in it.

Mr. Bucknall's Medication.

Take a quarter of an ounce of corrosive sublimate, reduced to powder, by beating with a wooden hammer, then put it into a three-pint earthen pipkin with about a glaſsful of gin or other spirit; stir it well together to diſsolve the sublimate. Fill the pipkin with common tar, and keep stirring the mixture till it be intimately blended. This quantity will be sufficient for two hundred trees. To prevent danger, let the sublimate be mixed with the tar as soon as poſsible after being purchased, it being of a very poisonous nature, and improper to be exposed, The medication to be applied with a painter's brush.



Mr. Wm. Fairman's Method of Extreme Branch Grafting.

ESSAY V.

On the comparative advantages attending the Purchase of Freehold and Leasehold Lands.

VARIOUS are the opinions respecting the comparative advantage attending the purchase of freehold and leasehold property. In favour of the former, the natural, and indeed laudable pride of man steps in, and decidedly determines. Most men wish to poſseſs property independent of all controul; and the suits and services exacted under many leases are a relict of feudal tyranny, highly disgusting to men fond of freedom and independence; but let us have recourse to figures and we shall find that two men starting together with one thousand four hundred pounds each, and purchasing, the one a freehold estate, of fifty-six pounds per annum, at twenty-five years purchase, and the other a leasehold for three lives, of one hundred pounds per ann. at fourteen years purchase, would be in very different situations at the end of twenty-one years. Calculating the interest of each at five per cent. and allowing three renewals,

at two years' purchase, (clear income,) the leaseholder's estate, of one hundred pounds per annum (nett) would, at the expiration of twenty-one years, cost him 1205l. 18s.; and the freeholder's estate, of fifty-six pounds per annum (nett) would, at the expiration of the same term, cost him 1900l. 1s. as the following calculation will confirm:

FREEHOLD, 56*l. per annum, (nett) and 25 years purchase.*

	£	s.	
	1400	0	
Add Interest	70	5	per cent.
	1470	0	
Deduct rent	56	0	
	1414	0	1st year
Add In.	70	14	
	1484	14	
Deduct rent	56	0	
	1428	14	2d year
Add Int.	71	9	
	1500	3	
Deduct rent	60	0	
	1444	3	3d year
Add Int.	72	4	
	1516	7	
Deduct rent	56	0	
	1460	7	4th yr.
Add Int.	73	0	
	1533	7	
Deduct rent	56	0	
	1477	7	

	£	s.	
	1477	7	5th yr.
Add Int.	73	17	
	1551	4	
Deduct rent	56	0	
	1495	4	6th yr.
Add Int.	74	15	
	1569	19	
Deduct rent	56	0	
	1513	19	7th yr.
Add Int.	75	14	
	1589	13	
Deduct rent	56	0	
	1533	13	8th yr.
Add Int.	76	14	
	1610	7	
Deduct rent	56	0	
	1554	7	9th yr.
Add Int.	77	14	
	1632	1	
Deduct rent	56	0	
	1576	0	

	£	s.	
	1576	1	10th yr.
Add Int.	78	16	
	1654	17	
Deduct rent	56	0	
	1598	17	11th yr.
Add Int.	79	19	
	1678	16	
Deduct rent	56	0	
	1622	16	12th yr.
Add Int.	81	3	
	1703	19	
Deduct rent	56	0	
	1647	19	13th yr.
Add Int.	82	8	
	1730	7	
Deduct rent	56	0	
	1674	7	14th yr.
Add Int.	83	14	
	1758	1	
Deduct rent	56	0	
	1702	1	15th yr.
Add Int.	85	2	
	1787	3	

	£	s.	
	1787	3	
Deduct rent	56	0	
	1731	3	16th yr.
Add Int.	86	11	
	1817	14	
Deduct rent	56	0	
	1761	14	17th yr.
Add Int.	88	2	
	1849	16	
Deduct rent	56	0	
	1793	16	18th yr.
Add Int.	89	14	
	1883	10	
Deduct rent	56	0	
	1827	10	19th yr.
Add Int.	91	7	
	1918	17	
Deduct rent	56	0	
	1862	17	20th yr.
Add Int.	93	4	
	1956	1	
Deduct rent	56	0	
	£ 1900	1	21st yr.

Freeholder's purchase of fifty-six pounds per annum, (nett,) allowing five per cent. compound interest, stands him at the end of twenty-one years in ..... £ 1900 1
First purchase 1400 0
Loss 500 1

LEASEHOLD, 100*l. per annum (nett) and* 14 *years purchase.*

	£	s.	
	1400	0	
Add Interest	70	0	
	1470	0	
Deduct rent	100	0	
	1370	0	1st year
Add Int.	68	10	
	1438	10	
Deduct rent	100	0	
	1338	10	2d yr.
Add Int.	66	19	
	1405	9	
Deduct rent	100	0	
	1305	9	3d yr.
Add Int.	65	5	
	1370	14	
Deduct rent	100	0	
	1270	14	4th yr.
Add Int.	63	11	
	1334	5	
Deduct rent	100	0	
	1234	5	5th yr.
Add Int.	61	14	
	1295	19	
Deduct rent	100	0	
	1195	19	6th yr.
Add Int.	59	16	
	1255	15	
Deduct rent	100	0	
	1155	15	

	£	s.	
	1155	15	7th yr.
Add renewal 2 yrs. purc. nett rent.	200	0	
	1355	15	
Add Int.	67	16	
	1423	11	
Deduct rent	100	0	
	1323	11	8th yr.
Add Int.	66	4	
	1389	15	
Deduct rent	100	0	
	1289	15	9th yr.
Add Int.	64	10	
	1354	5	
Deduct rent	100	0	
	1254	5	10th yr.
Add Int.	62	14	
	1316	19	
Deduct rent	100	0	
	1216	19	11th yr.
Add Int.	60	17	
	1277	16	
Deduct rent	100	0	
	1177	16	12th yr.
Add Int.	58	18	
	1236	14	
Deduct rent	100	0	
	1136	14	

	£	s.	
	1136	14	13th yr.
Add Int.	56	17	
	1193	11	
Deduct rent	100	0	
	1093	11	14th yr.
Add renewal	200	0	
	1293	11	
Add Int.	64	14	
	1358	5	
Deduct rent	100	0	
	1258	5	15th yr.
Add Int.	62	18	
	1321	3	
Deduct rent	100	0	
	1221	3	16th yr.
Add Int.	61	1	
	1282	4	
Deduct rent	100	0	
	1182	4	17th yr.
Add Int.	59	2	
	1241	6	
Deduct rent	100	0	
	1141	6	18th yr.
Add Int.	57	1	
	1198	7	
Deduct rent	100	0	
	1098	7	19th yr.
Add Int.	54	18	
	1153	5	
Deduct rent	100	0	
	1053	5	20th yr.
Add Int.	52	13	
	1105	18	
Deduct rent	100	0	
	1005	18	21st yr.
Add another renewal	200	0	
	1205	18	

Leaseholder's purchase of one hundred pounds per annum, (nett) allowing five per cent. compound interest, stands him at the end of twenty-one years (admitting three renewals at two years purchase nett income) in the sum of £1205 18

Profit	194 2
First purchase	1400 0
Freeholder's loſs at five per cent	500 1
Leaseholdor's profit at ditto	194 2
Difference	634 3

Since this calculation was made, the value of freehold and leasehold lands have increased, but that will not disturb the conclusion here drawn, as the purchases observe their proportions.

N. B. A deduction should be made from Leaseholder's profit, for lord's rent and heriots, and something from Freeholder's loſs, for increasing value of timber.

The great cause why leaseholds are held in low estimation by the commonalty, arises from the improvidence of the general holders, who for the most part expend the whole income of their estates, without laying by a fund for the purpose of renewal; hence it follows, that their estates fall into hand, and the owners are often reduced from a state of comparative affluence to beggary.

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ESSAY VI.

On the Mulberry-Tree.

OF the Mulberry there are six species, but I shall only mention two, as they are the only ones that can profitably be raised in this country.

1. MORUS *(nigra)* foliis cordatis scabris. Linn. Sp. Pl. 1398. *Mulberry with rough heart-shaped leaves.* THE BLACK MULBERRY.

a. A male catkin. B. The calix magnified. *c*. A male flower. C. Ditto magnified. D. One stamen magnified. *e*. A female catkin. *f*. A female flower. F. Ditto magnified. G. The calyx magnified. H. The embryo, with its two stigmata, magnified. *i*. The fruit, consisting of many berries. *k*. A single berry. *l*. A seed. L. Ditto magnified.

This tree is remarkable for putting out its leaves late, so that when they appear, the gardener may take it for granted, that all danger from frosts is over; he may then expose his green-house plants. *Cum germinare videris Morum, injuriam postea frigoris timere nolito.*—PLIN.

Ovid on account of its blood-red appearance, has chosen the Mulberry tree for the scene of his affecting story of Pyramus and Thisbe; and indeed, no other tree could have given so much assistance to the imagination of the Poet. Horace advises us to finish our dinners with ripe Mulberries:

> ——————————Ille salubres
> Æstates peraget, qui nigris prandia Moris
> Finiet, ante gravem quæ legerit arbore solem.

2. Morus *(alba)* foliis oblique cordatis lævibus. Linn. Sp. Pl. 1398. *Mulberry with oblique, smooth, heart-shaped leaves.* The White Mulberry.

The first, or Black Mulberry, is cultivated for the delicacy of its fruit. It grows naturally in Persia from whence it was brought to the southern parts of Europe, and is now common in all parts where the winters are not very severe.

The second, or White Mulberry, is only raised for feeding silk-worms, in China, Italy, and France; but within these few years it is raised in some parts of the Prussian dominions for the same purposes. Count Hertzberg informs the Board of Agriculture, that great

progreſs is made in the national silk of Pruſsia, in which kingdom there are upwards of one thousand places succeſsfully engaged in the culture of silk. He seems to think that their manufactures are likely to prosper, as those of Lyons fall into decay. If silk can be so readily obtained in Pruſsia, there can be no doubt of its succeſsful cultivation in the southern parts of this Island. The different operations required for making silk ready for the loom, call forth little more addreſs than the formation of a pin. As long as the Mulberry-tree continues to thrive so luxuriantly with us, we must not desert the thoughts of seeing silk manufactured in this country from the egg to the loom.

Mr. Evelyn, in his chapter on the Mulberry tree, is of opinion, that silk may be produced in this country to a great national advantage, provided, as he expreſses himself, "that the "indigent and young daughters of proud "families would be as willing to gain three "or four shillings a day for gathering silk, "and busying themselves in this sweet and "easy employment, as some do to get four-"pence a day for hard work at hemp, flax, "and wool." From this it evidently appears

that Mr. Evelyn did not entertain a favourable opinion of the mode of educating the young women of fashion in his days. In his *Mundus Muliebris,* a very scarce book, written professedly to contrast the times, he has drawn a picture descriptive of the polite manners of the year 1664. If it do not instruct, it will at least amuse the fine ladies and gentlemen of the present day.

" The refined lady expects her servants and humble admirers should court her in the forms and decencies of making love in fashion. In order to this you must often treat her at the play, the park, and the music; present her at the raffle; follow her to Tunbridge at the season of drinking the waters, though you have no need of them yourself. You must improve all occasions of celebrating her shape, and how well the mode becomes her, though it be never so fantastical and ridiculous; that she sings like an angel; dances like a goddefs; and that you are charmed with her wit and beauty. Above all, you must be sure to find some fault or imperfection in all other ladies of the town, and to laugh at the fops like yourself. With this a little practice will

qualify you for the conversation and mystery of the Ruelle; and if the whole morning be spent between the glaſs and the comb, that your peruke sit well and cravat strings be adjusted, as things of importance; with these and the like accomplishments you'll emerge a consummate *beau*, Anglicè, a *coxcomb*. But the dancing-master will still be neceſsary to preserve your good mien, and fit you for the winter ball. Thus you see, young sparks, how the style and method of wooing is quite changed, as well as the language, since the days of our forefathers, (of unhappy memory, simple and plain men as they were!) who courted and chose their wives for their modesty, frugality, keeping at home, good housewifery, and other economical virtues then in reputation. And when the young damsels were taught all these in the country, and their parents' houses, the portion they brought was more in virtue than money, and she was a richer match than one who could have brought a million, and nothing else to commend her. The presents which were made when all was concluded, were a ring, a necklace of pearl, and perhaps another fair jewel, the *bona paraphernalia* of her prudent mother, whose nuptial kirtle gown and petticoat lasted as

many anniversaries as the happy couple lived together, and were at last bequeathed with a purse of old gold, rose nobles, spur-royals, and spankers, as an heir-loom to her grand-daughter. They had cupboards of ancient useful plate, whole chests of damask for the table, and store of fine Holland sheets (white as the driven snow, and fragrant of rose and lavender) for the bed, and the sturdy oaken bed-stead and furniture of the house lasted one whole century; the shovel-board and other long tables both in hall and parlour were as fixed as the freehold; nothing was moveable save joint-stools, the black-jacks, silver tankards, and bowls. And though many things fell out between the cup and the lip, when Nappy Ale, March Beer, Metheglin, Malmsey, and Old Sherry got the ascendant amongst the blue-coats and badges, they sung *Old Symon* and *Cheviot Chase*, and danced *Brave Arthur*, and were able to draw a bow that made the proud Monsieur tremble at the whizze of the grey-goose feather. 'Twas then antient hospitality was kept up in town and country, by which the tenants were enabled to pay their landlords at punctual day; the poor were relieved bountifully; and charity was as warm as the kitchen, where

the fire was perpetual. In those happy days, *Surefoot*, the grave and steady mare, carried the good knight and his courteous lady behind him to church, and to visit the neighbourhood, without so many hell carts, rattling coaches, and crew of *damme lacqueys*, which a grave livery servant or two supplied, who rid before and made way for his worship. Things of use were natural, plain, and wholesome; nothing was superfluous; nothing neceſsary wanting; and men of estate studied the public good, and gave example of true piety, loyalty, justice, sobriety, charity, and the good neighbourhood composed most differences. Perjury, suborning witneſses, alimony, avowed adulteries, and miſses (publicly owned,) were prodigies in those days, and laws were reason not craft, when men's titles were secure, and they served their generation with honour; left their patrimonial estates improved to an hopeful heir, who paſsing from the free-school to the college, and thence to the inns of court, acquainting himself with a competent tincture of the laws of his country, followed the example of his worthy ancestors; and if he travelled abroad, it was not to count steeples, and bring home feather and ribbon, and the sins of other

nations, but to gain such experience as rendered him useful to his prince and country upon occasion, and confirmed him in the love of both of them above any other. The virgins and young ladies of that golden age *quæsiverunt lanum* and *linum;* put their hands to the spindle, nor disdained they the needle; were obsequious and helpful to their parents; instructed in the managery of the family, and gave presages of making excellent wives; nor then did they read so many romances, see so many plays and smutty farces, set up for visits, and have their days of audience and idle pastime. Honest *Gleik, Ruff and Honours*, diverted the ladies at Christmas, and they knew not so much as the names of *Ombre, Comet*, and *Baſset*. Their retirements were devout and religious books, and their recreations in the distillatory, the knowledge of plants and their virtues, for the comfort of their poor neighbours, and use of the family, which wholesome plain diet and kitchen physic preserved in perfect health. In those days, the scurvy, spleen, &c. were scarce heard of, till foreign drinks and mixtures were wantonly introduced. Nor were the young gentlewomen so universally afflicted with hysterical fits, nor, though extremely modest, at all melancholy, or leſs gay, and in

good humour; they could touch the lute and virginals, sing "*Like to the damask rose;*" and their breath was as sweet as their voices. They danced the *Canarys*, *Spanish Pavan*, and *Sillenger's Round* upon sippets, with as much grace and lovelinefs as any *Isaac*, *Monsieur*, or *Italian* of them all can teach with his fopcall, and apish postures."

ESSAY VII.

On the Smut in Wheat.

OF the smut there seems to be two kinds; the one comes out a little earlier than the other, but both have the smut formed in what I call the uterus, or folium vaginans, some time before the ear makes its appearance. The one, that is the most early, comes out naked, the whole of its chaff being destroyed, so that the dust is mostly carried off by the wind before the crop is harvested. This kind is considered as the least destructive of the two,

as the infected ears can and may be removed when spread upon the thrashing-floor. But I am not quite certain whether the wind may not be the means of conveying it to sound ears, at that time hastening to maturity in the same field. The other kind of smut does not destroy the chaff, so that the ear puts on a healthy appearance. The smut is contained in round bags, composed of a dark green cuticle, from which, when broken with the flail, the black powder is discharged. This is more dangerous than the other, as the smutty ears cannot be distinguished from such as are sound, even when placed upon the thrashing floor. The smut is evidently a minute vegetable body of the order of fungi, and may properly be considered as a parasitical plant; but how it comes, at so early a period, to take poſseſsion of the infant germ, and to grow up with it, is a matter hitherto unknown. It is most certain that when this black powder is rubbed upon sound grain, that the produce will in general be smutty. I have sometimes found sound ears to arise from an infected root, and I have seen, though but seldom, sound and smutty grains in the same ear.

The whole of this part of natural history is

wrapt up in obscurity; but it is a singular happineſs that the vegetative principle of smut may be destroyed by certain steeps, well known to the farmer. These seem to operate in a twofold capacity, by destroying the germination of the smut, and by allowing the farmer to skim it off during the time of brining. When stale urine and lime are alone used, it is plain that the cultivator has no view beyond the destruction of the vegetative principle of the smut, a practice recommended by many judicious farmers in preference to brining and steeping. But when stale urine is used, care should be taken not to permit it to remain too long upon the grain. I have very respectable authority for saying, that seed wheat, well washed in water, is as effectually secured against smut as if it had been subjected to the most approved steep. The smut is certainly more prevalent in some years than others, but this is in common with many kinds of weeds, which spring up more luxuriantly in some years than others.

ESSAY VIII.

On Summer Fallowing.

THE present century was somewhat advanced before the two great acquisitions of modern husbandry, turnips and clover, were very generally substituted in lieu of fallows upon light land: until they were introduced, sand, and the dryest loams, were summer fallowed upon the very same principle, and nearly with equal tillage as clays at present. This is apparent through all the old writers on husbandry*, from a variety of paſsages. And this system was thought as neceſsary upon one soil as upon another. There are not wanting writers who tell us, that this is the case now.

But when those noble plants were well

* The practice of summer fallowing is not only very ancient, but the three ploughings given are so also. In the early age of Greece this was the number. *Hom. Odyss.* lib. 5. v. 127. *Hesiod Theog.* v. 971. *Salmas. Plin. Exercit.* p. 509. *Le Clerc Not. in Hesiod*, p. 264. 266.

established, it was found that dry land was tilled and managed much better by means of turnips, which left only half a summer for ploughing, than when the whole was employed in it; and that clover upon both wet and dry land had a similar, or even greater effect, that left no time at all for ploughing. These were facts that seemed to produce an entire revolution in agriculture, not only in its practice but in its theory; for if as good, and even better wheat was gained after clover, that produced two large crops of hay; or one of hay and one of straw and seed to a much greater weight and amount than any thing that could be left in the ground in roots, &c. it clearly proved that ploughing and turning the soil to the atmosphere was not neceſsary either for the destruction of weeds, or for enabling it to attract I know not what acids, alkalies, oils, &c. with which the soil was supposed to be thus impregnated, and proportionably to the duration, the culture of turnips proved the same thing.

In the same period the cultivation of some other crops, called ameliorating ones, spread very much; such as pease and beans, and tares or vetches. All these smothering crops,

as well as clover, excluded the sun through the whole summer, leaving no time for fallowing, yet the wheat or barley sown after them was as good as that that usually succeeded a fallow*; and what is remarkable, proved always good in proportion to the greatneſs and thickneſs of such crops of pease, beans, tares, and clover.

The good cultivation which was thus introduced from Flanders, (where it had subsisted several centuries,) was principally established in the four eastern counties that lie against the Flemish and Dutch coast, taking root chiefly on dry land, owing to turnips succeeding well only on such soils. From these counties it has gradually been creeping further and further, and wherever it extends, clearly

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* Even in parts of the kingdom where husbandry is backwardest, many persons have found that smothering crops prepare as well as any fallow: thus in Scotland the Earl of Selkirk found that pease, cut in full bloom, for hay upon clay land, was as good as a summer fallow. *Wight's Pres. St. Husb.* vol. 3. p. 101. Dans notre pays, says a French writer, on y seme du trefle qui fait beaucoup de bien a la terre *en la garantiſsant de l'ardeur du soleil*, et en lui conservant la rosee et la pluie. *Bomare Dict. d' Hist. Nat.* tom. 3. p. 438. art. *Lin.*

proves that summer fallowing is not neceſsary, upon the principle of enabling the soil to attract the vegetable food from the air.

But this practice, nor that principle, have yet established themselves on soils too wet for turnips, except in certain districts. In Kent it took place very generally by means of beans; and in parts of Norfolk, Suffolk, and Eſsex, partially by the same plant. As far however as clover is concerned, it has become almost universal. The great question at present that demands to be resolved, is the application of this principle for the entire banishment of fallows proper to be universally extended to wet, as it has been to dry soils.

This question must be considered in relation both to fact and reason*. In regard to the first, which is what chiefly ought to govern us, the point is decided as soon as named, for a general practice which extends through a part of Kent proves it. They have been for

* In China we are told that the land, whatever the soil, never lies fallow. *Ephemerides du Citoyen*, 1767, tom. 11. p. 59.

these fifty years in the habit of substituting beans instead of fallows, and gaining as fine crops of wheat after them as are to be seen in any part of the kingdom. All their dung is spread for beans, and they are drilled and horse and hand-hoed to great perfection. Smaller districts, in other counties, I have seen, where beans have also been thus substituted with very great succeſs. But in this point I consider the practice of Mr. Arbuthnot and his eléve, Mr. Chambers, during nine years, as being yet more decisive than the more general practice of whole districts, and for two reasons: First, their soil was exceedingly strong, wet, adhesive, and churlish, as untoward land to manage without a fallow as ever was seen. Secondly, they adopted a course of crops in which this husbandry was more like to fail than in almost any other, which was, 1st, Beans. 2d, Wheat. 3d, Clover. The last crop, when it returns often, or when the soil is not kept perfectly clean, is apt to foul land, and let the couch *(triticum repens)* establish itself. Much, therefore, depended on the beans answering all the purposes of a fallow, not only in that respect, but also in the wheat being put in so well as to secure the clover-seed taking, which is a cri-

tical point where the management is not very good. The result was, that their husbandry succeeded to admiration, and was the best, and their crops the largest that ever I saw on land equally unfavourable. Their fields thus managed were also in an almost garden degree of cleanneſs: insomuch that if ever there was a fact established by practice, it was the perfect dependence that might be placed on beans as a succedaneum for fallow. Fact cannot be more decisive on this question than it is.

Nor is it only with beans and clover that this fact takes place. In almost every part of the kingdom pease are used as a preparative for wheat, provided the crops prove large. I have seen innumerable instances of this husbandry attended with the greatest succeſs; but never if the pea crop is thin and poor: whenever farmers are so ill-advised, or avaricious, as to put in wheat after half a crop of pease, they are as universally disappointed as they are sure of a crop after a large one, which seems to prove this doctrine beyond a doubt. It is the same with tares.

But I have another observation to make

much more uncommon, but which, I believe, is equally true. It is, that the land which has yielded a very great bulky crop of white corn, when sown with any crop, will give a greater product than a field managed exactly in the same manner, but that yielded a thin or poor crop. This is remarkable; for white corn is, beyond all dispute, an impoverisher; and, consequently, the more there grows of it, the more the land ought to be exhausted. What, therefore, counteracts this effect? Certainly the thick shade of a great crop: which is so much the more clear, because in those spots where it is laid, or beaten down by the weather, there the land is left in the finest order and the greatest fertility. Whoever will attentively observe their crops with a view to this circumstance, will be convinced of the fact, (to whatever cause it may be attributed,) independent of any richneſs arising from other causes, such as dunging, &c.

But fact ought also to give us remarkable instances of the benefit of extraordinary summer fallows, supposing them to be as efficacious as some would insist. Instances are, however, to be produced to the contrary.

Mr. Crow, of Yorkshire, fallowed a piece of strong land two years succeſsively for experiment, and the result was a very poor crop, from plaistering*. Much tillage, in such a succeſsion, cannot be given without a great degree of pulverization, which, upon many soils, never happens without being fatal. They run together like wet mortar, and bake when the sun shines. Dr. Walker, near Elgin, fallowed for two years, ploughing fourteen or fifteen times, and every crop after it was bad†.

Viewing an estate in Hertfordshire, I brought away some specimens of the loams. One of these was kept in a drawer seven years: being then engaged in a course of trials on the food of plants, I filled a pot with this earth, and though for that period no sun, nor even light, had come at it, yet the fertility of it was very extraordinary; but the contrary ought to have been the case, had summer fallowing been neceſsary to impregnate the soil with the riches of the atmosphere.

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* Six Months' Tour, vol. 2. p. 226.

† Wight's Pres. State Husb. Scot. vol. 5, p. 89.

And now as to reason. A fallow has three objects: 1st, Killing weeds. 2d, Attracting the vegetable food from the sun or air. 3d, Giving sufficient friability. That the bean culture will keep land clean, is a fact that does not depend on the ingenuity of individuals—all Kent is a proof of it: from Dartford to Dover they are in what they call the round tilth, that is, 1st, Barley. 2d, Beans. 3d, Wheat: thus two crops of white corn come together, which is so far a bad course, yet the land is clean, and every man that sees their crops must allow their husbandry good. This could not be in the nature of things, if the beans did not admit operations sufficient for the total destruction of weeds. This point is so well established by practice, that I never heard it disputed by men who had seen a good bean culture. But all depends on great use being made of the hoe. In Kent they bestow from fifteen to twenty shillings an acre in hoeing.

As to the second object of a fallow, that of attracting the vegetable food:—I shall not inquire whether the food of plants resides in the air—it is sufficient to show, that if it does, there is nothing in clover, beans, pease, vetches, &c.

that can prevent the soil acquiring that food; or, at least, if they do prevent it, they, at the same time, furnish something else that makes ample amends for the loſs, such as roots and leaves to putrify. That this must be the case, appears clearly from the wheat crops being very generally better after clover than after a fallow*; and also from their succeeding proportionably to the smothering thickneſs of a crop of pease. The thicker this crop is, the more the air is excluded, yet the better is the wheat. But is the air excluded in any of these cases? Certainly not: rain, dew, and air, penetrate the crop, and reach the land, but exhalation by the sun is prevented, which may be an advantage; but whether this reasoning be right or wrong, the fact remains; no man in his senses has a great crop of pease without sowing wheat on the land, though he will hesitate if the pease be small.

The last object of fallowing, that of giving

* The miserable crops gained sometimes by fallow on good land, is a strong confirmation of the above reasoning. I was aſsured, in the rich vale of Aylesbury, that they had for some years no more than from 12 to 15 bushels an acre of wheat.

friability, is likewise attained by these fallow crops. No repetition of ploughing will make land more loose and friable than a great crop of pease or tares; let the plough enter immediately after they are cleared, and a man is surprised to see what order his land is in. It is the same, to a proverb, with clover. If the bean culture is good, it leaves time for three earths, which is enough to remove all objections, did any remain. But the facts I have already quoted prove this point also; for succeſs could never be found on strong lands without friability given in some way or other. To say, therefore, that great crops of wheat and clover are gained after beans, is to say that beans make strong land friable, otherwise those products could not be gained.

It is thus that reason seems to justify the conclusions, drawn from fact; and, I trust, that I am founded in having rejected the neceſsity of fallowing. I consider it as a practice that ought more to have given way when clover and turnips, being generally established, showed that there was no physical neceſsity for this mode of conducting arable land. The idea, however, was generally accepted, only on dry land, by means of turnips; be it

the business of the present age to extend it the other step—and then our agriculture is complete.

The most powerful theory that is brought in aid of fallowing, is that of the land imbibing some igneous or other particles by being exposed to the immediate action of the sun's rays*. Let it be considered, that if those rays impart that corpuscular influence about which so much was written in the last century; they ought to be imparted much stronger in very hot tropical climates, than in others that are more northerly; the contrary, however, is remarkably the case, for I have been assured by some very attentive gentlemen who have resided in Jamaica, and whose business there was agriculture, that exposing a soil for any continuance of tillage to the influence of a burning sun, has, on long experience, been found so pernicious that they avoid it sedulously. In the other islands also they observe the same thing. Martin, of Antigua,

* M. Beunie seems to be of this opinion. *Essai Chemique des terres, in the Mem. de L'Acad. des Scien. de Bruxelles*, tom. ii. p. 404.

a great advocate for fallowing, is sensible of this circumstance, in mentioning the advantage of fallowing by imbibing vegetative powers whenever rain falls *. Another tells us the land in the sugar islands should be covered with cane trash to keep them from the vehement action of the sun, especially if dunged †. Observations to a similar purpose have been made in various other places. "It requires," says Kalm, speaking of the Pennsylvanian husbandry, "infinite time and labour to recover exhausted fields, especially where they are so scorched by the excefsive heat ‡." But this circumstance of scorching ought rapidly to recover a field instead of retarding it, were the theory true which establishes the use of summer fallows. And Bartram speaks of land in East Florida, rich, because the sun never shines on the ground, through the thick shade, to exhale the virtue of the rotten leaves. We are informed also, that in Sumatra, whose equinoctial situation with the incefsant lightnings it is subject to, should make one expect that the sun's immediate action would prove

* Efsay on Plantership, p. 23.

† Art of Making Sugar, 4to. 1752, p. 5.

‡ Travels in North America, vol. 1. p. 186.

(if any where) salubrious: that the culture of dry rice is all on the site of old woods, and not on plains, for they do not afford vegetable mould enough, being exhausted by the powerful operation of the sun's rays*. Nor will they do for pepper, their long exposure to the sun exhausing the source of their fertility†.

Lord Kaims‡, consistently with the same idea, observes, that the dew which falls on a leguminous crop is shaded from the sun by the broad leaves, and sinks at leisure into the ground‖. And a Frenchman, otherwise absurd enough, had sagacity to find out that fallows are useleſs, and even pernicious§. Count Gyllenborg, by very scientific deductions, offers some circumstances that have

* Marsden's History of Sumatra, p. 61.

† Ibid, p. 116.

‡ Journal up the River St. Juan, annexed to Stork's Florida, p. 8.

‖ Gentleman Farmer, p. 127.

§ Reflections sur l'Etat actuel de l'Agriculture, 12mo. 1780, p. 37, &c.

considerable weight in this inquiry: mould exposed to the solar heat loses, he says, its oily particles*; and that in shady places it is richer than where exposed to the sun†. And Neuman, equally on experiment, declares, that heat draws the rich exhalations out of the earth‡.

Mr. Wight, in a correspondence on this subject, observes, that the richest woodlands in Jamaica are exhausted in twelve years by sugar‖. This I attribute to the action of clearing those weeds and letting the sun in.

A French writer observes, that land ploughed too much loses all its salts§; but this is in the teeth of most of his countrymen, who think fallow neceſsary: one calls fallow and dung for wheat, the base of agriculture**.

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* Nat. and Chem. Elem. of Ag. p. 85.

† Ibid. p. 87.

‡ Ibid, p. 182.

‖ Pres. St. Husb. Scot. vol. p. 718.

§ Model. Recreat. Phys. par Parmentier, tom. 2. p. 65. Recherches sur les Vegetaux, p. 423, 432.

** Bomare Dict. d'Hist. Nat. tom. 1. 307.

These observations seem remarkably to exclude these igneous particles; but neither these nor reason seem at all to combat the idea of particles of this sort which plants take in, in moisture, rain, and dew, being richly impregnated with bodies salutary to vegetation, and which the atmosphere abounds with; and are a more likely way of conveying them to the roots than any other.

Notwithstanding I have been so sedulous to reject both the theory and practice of summer fallowing, I am ready enough to admit that there may be cases on clay in which a farmer might find it advantageous. Newly entering land that is filled with weeds by a long succeſsion of bad management, he may not be strong enough to put beans into all the land that want cleaning. When a field is intended for graſs, that is so weedy that one crop of beans may not be enough to clean it, without an extreme of attention that cannot be given, in these, and in some other cases, poſsibly a complete summer fallow may be advisable; when it is so, the following hints for the management of it may have their use.

All strong soils that run into a maſs of mud

with rain, and bake, with a hot sun, should, in fallowing, never be ploughed or harrowed fine until the heat of the summer is over; and at any season the harrow may as well be kept off, unleſs in the burning season to tumble clods about without breaking them.

An autumnal ploughing, followed by another in a very dry season, in May, or early in June, according to the weather, and left in as rough a way as poſsible by a croſs ploughing, just before harvest, is all it should have. These clods* will roast in the sun, and root weeds of all sorts will be greatly checked, and many of them killed. Whereas if more tillage was to break the soil much, not one root in many would be destroyed. Mr. Arbuthnot, in the very little fallowing with which he brought his clay lands into order, pursued this plan with great succeſs; towards the time of the tillage to be given for wheat he chose a burning season to crush the clods with his spike roller; but the Norfolk heavy drill roller answers the purpose far better.

* Mr. Robertson, of Scotland, on his coarse clay, keeps his fallows as full of clods as poſsible. *Wight's Pres. St. Husb. Scot.* vol. 2. p. 105.

ESSAY IX.

On Farm-Yard Management.

MY management differs, in some respects, from the common practice, though I think since I have been a farmer every occupier of land is becoming more active, and more industrious in collecting materials for manure; and almost every one has some little system of his own to go by in this part of his business: mine is as follows. During the whole course of the summer I gather into stacks all the weeds and rushes I can meet with, and bed my yard at any leisure time with good mould from a neighbouring common, a foot and a half, or two feet thick. After harvest I get from this common as many loads of fern as I can, usually eight or ten, and spread it over the earth, into which my cattle generally tread it pretty well before they come to be stationary in the yard for the winter. I likewise mow all my wheat stubbles, which I always leave very high, principally because we are not allowed to sell wheat-straw; and,

indeed, if we were, we have no market for it near enough to make the sale an object. This stubble I make into regular ricks, and slightly thatch them. When the season calls the cattle into the yard, I immediately tie up my ten dairy cows, and only let them out about half an hour, night and morning, to drink at the pond, which is at one corner of it; this yard is appropriated to my cows, and in bad weather to my sheep. I feed the cows with sliced turnips, and barley or oat-straw cut into chaff. I have one of Cooke's cutters, which does this business excellently. I bed their stalls with plenty of stubble every night, and clean them out as regularly as my stables, and pile the dung about six feet from the door of the sheds. With this sort of care, and warmth, and food, my cows look sleek and well all winter. As soon as they calve, with the sliced turnips I give good hay and wheat-straw, half and half, cut into chaff, and when turned to pasture in the spring they look as well as most other peoples' do after they have been at grass six weeks. I also buy in, in the middle of November, ten or a dozen Welch runts, that will fat to about seven or eight and twenty score. They are so unhandy and rude, that I have given up at-

tempting tying them, and feed them in covered mangers in a small warm yard, with sliced turnips and chaff, half hay and half any sort of straw, and litter round their mangers plentifully with stubble, and have the dung thrown into heaps once a week. These oxen go off the latter end of April and beginning of May, and pay about four pounds a-head for twenty weeks keep. I always store up ten or fifteen waggon loads of turnips against bad weather, and if my stock of them fails from any cause, I am never without potatoes to supply the defect, so that I contrive by these means, and taking care not to overstock, to get through the backwardest spring without the difficulty and distreſs and real loſs I have, in the course of my life, observed many people suffer. I never rear any young cattle, having no good means of summering them. I never give hay or straw uncut to any cattle; and by this management I have not the smallest doubt but I keep, I mean winter, twice as many beasts as I could in the common manner of treatment, and get together likewise an immense quantity of uncommon strong manure; so strong, that I rarely put more than six three horse dung-pot loads upon an acre for pease, beans, tares, or turnips, which

are the four crops I generally dung for. When the weather becomes very severe, I drive my whole flock of ewes, between 17 and 18 score, into the cow-yard, which is dry and warm, about three o'clock in the afternoon, and give them hay and straw chaff in troughs: they fill their bellies heartily, and lie comfortable and snug. In the morning I turn them into the turnip field, to eat up clean those that are drawn, and in the evening they return to the yard, which they are always eager to do. The latter end of February, when they begin to lamb down, I divide my yard by flakes, and keep the forward and backward ewes apart, and by this care, and warmth, have usually good luck. I then add to their chaff potatoes, or turnips, crushed in a cyder mill, and they keep gaining, notwithstanding the pull of their lambs, till they are turned into the water-meadows the middle of March.

My horses are, winter and summer, in the stable, in which there are no racks, as like the other cattle, all their food, equal hay and straw, is cut into chaff, and they have the same allowance of oats winter and summer, namely, one bushel each per week, and are always in good working order—rather sleeker

and fatter to be sure with the lucern in summer. By these various means I collect a very large quantity of rich manure, and keep all my stock in good heart and looks. I carry the dung immediately from the yards to the fields; and though it is not so rotten as many people like, I have reason to know, from experience, that my mode answers well.

ESSAY X.

On the Mixture of Agriculture and Manufactures.

Some think that the mixture of agriculture and manufactures ought not to be recommended, being of opinion, that the two employments must be carried on to greater perfection when divided, than they can posibly be by one person. But while in one view this opinion is well founded, in others it certainly is not. A manufacturer would, no doubt, be unfit to manage a large farm; but it does not appear how in any way he could be hurt by

having the charge of a garden, or even of an acre or two; which would commonly be all kept in grafs for his cow, excepting such parts of it as he might wish to work with the spade for the production of potatoes, and other articles usually obtained from gardens. Even this occasional occupation with the spade, however, would, in the opinion of many, prove injurious to manufacturers, from their being afraid that it would occupy time which otherwise might be employed with more benefit to himself and to the public. But men who argue in this manner, build their opinion on speculation, and not on practice and observation. They do not consider the nature of man, who must have some variety in his pursuits, otherwise he will be unhappy; and we all know how unproductive that labour must be, while those by whom it is carried on are discontented, or not satisfied with their situation. It appears, indeed, to be unreasonable, to insist on a weaver spending every moment of his time at his loom, or a smith at his anvil: accordingly it is seldom or never done; for this clafs of men, when deprived of the more rational occupation of working and taking charge of a small portion of ground, for the benefit of their families, seldom fail to

spend a considerable part of their time in the ale-house, and not more than a few days of every week at their work. Whereas, it is almost every where remarked, that this seldom happens with any of those manufacturers who have not hitherto been collected together, but working separately, and often at a distance from each other, frequently poſsefs an acre or two of ground, in the management of which they not only derive amusement and happineſs, but they and their children, while employed in this manner, become more robust and healthy, and imbibe much more virtuous principles than are commonly met with among those manufacturers who do not enjoy this advantage.

The influence of this is very remarkable in the difference which, in these circumstances, takes place between cotton manufacturers who, in general, are collected together in great numbers, often to the extent of more than a thousand, and those who carry on the manufacture of our national broad-cloth. These last, almost every where work separately and unconnected with each other, and employ all the hours which they devote to relaxation and amusement, in the care of

their gardens, and other small portions of ground that they poſſeſs; to which they and their families become commonly so much attached, that they have been known to remain in them, small as their poſſeſsions commonly are, for many generations. Nor does this variety of occupation make them worse tradesmen, or induce them to work leſs, as some speculative men have supposed it would do, while, in various ways, it tends to make them more virtuous citizens. These manufacturers are every where noted for their industry, and for the quantity of cloth which they produce; and we all know that the article itself, which has long been considered as the staple commodity of our country, is the best of its kind that any where can be met with.

Some manufacturers neceſsarily require the united labours of many workmen; but this is not frequent; nor do we know of any that absolutely require such numbers to be employed in one body as to prevent the poſsibility of their being all supplied with small portions of ground. It may be for the interest of a few large money-proprietors, to collect manufacturers in great numbers together, and thus

to enjoy the profits of their accumulated labour; but this being highly detrimental both to the morals and health of those whom they employ, and being thereby injurious to the whole nation, it is surely full time that to the very extensive length to which undertakings of this kind are frequently carried, some check or regulation should be applied.

The most desirable, and, perhaps, the most effectual mode of doing this, would be for the Board of Agriculture, when poſſeſsed of powers and funds sufficient for the purpose, to establish and support a plan for giving to every manufacturer, in all districts that admit of it, one, two, or more acres of ground, according to the richneſs of the soil, and other circumstances of his situation. The desire which universally prevails among the lower claſses of people for this kind of poſſeſsion, being every where great, were a plan of this kind to take place, a great proportion of manufacturers who are now collected in large bodies would separate, and become more industrious, more useful, and better members of society, than they are ever likely to be while their present mode of life is pursued.

In various ways, a scheme of this kind would prove useful both to farmers and proprietors of land, as well as to manufacturers and the public. If unimproved grounds were, in general, allotted for this purpose, of which almost every farm in the kingdom contains a proportion, a very considerable quantity, to the extent of some millions of acres, that are now almost altogether unproductive, might thus be quickly improved to the highest degree of cultivation, and at a little or no expense; for small portions of land, poſseſsed in this manner by individuals, are managed with no other expenditure of time, the chief article of expense, it may be remarked, with which all agricultural improvements are attended, than of that which otherwise would be spent in idleneſs. The very highest rents would be cheerfully given for ground occupied in this manner; and by a great proportion of manufacturers being disposed over the kingdom, their wives and children would, in busy seasons, prove an useful and important addition to the numbers usually employed in farming operations.

ESSAY XI.

A Political Renovation addreſsed to the year 1812.

THOUGH much exertion is, at this present time, used by all ranks of people to rescue us from the cruel fangs of a rapacious invader, yet all will but little avail till our national debt be made lighter. To accomplish this desirable end, much self-denial will be required, even to an extermination of all our levities and luxuries. I wish to begin our renovation by sending all our plate, both public and private, to the mint, to be converted, as speedily as poſsible, into money, in order to fill the nation with circulating cash; after which, let every person poſseſsing property, faithfully give a large portion of it at stated payments (suppose one-sixth of all that he is worth) towards the leſsening or liquidation of our national debt. Such a scheme, however Utopian it may appear, seems to be the only one capable of renovating this nation; but to

effect it, our manners and opinions must instantly undergo a wonderful change. To begin, let the strictest morality be practised where it is preached; and in order to preserve the utmost harmony between the ministers of the gospel and their flock, let all tithes be abolished, giving to the minister and lay impropriator, such a fair and equitable compensation as the wisdom of parliament may think proper. To this the clergy ought to have no objection, as by my scheme they will be enabled to bring up and maintain their families at lefs than half their present expense. I consider this as a *sine qua non*, and should be the first act of a nation that is rising from its ashes. To begin this great work of national reformation, let all public places of amusement and expense be shut up by general consent, for I argue against all compulsion, trusting that an universal and warm return to virtuous patriotism will do it. Let us reduce ourselves, for some years, to live upon the humble fare, that is the produce of our own lands. When so far advanced, the whole order of things will be changed, and we shall no longer be the men we now are. I mean us to be reduced to three clafses, husbandmen, fishermen, and manufacturers, and let no man

be idle. Let the superfluous product of our lands, (for then there would be a superfluity) together with our manufactured goods, be exported, and the returns, for a limited time, only accepted in coin, bullion, or raw materials, for the use of the manufacturer. The produce of our Colonies to be scantily consumed at home, and the surplus to be sent abroad. Under such a system of national frugality, our corn and manufactured goods may be made to fill the foreign markets at a price that would supersede all competition. Let us keep up a powerful fleet to protect our trade, and secure to us the dominion of the seas; and let a sufficient military force be maintained to support magistracy and overawe all disturbers of the public peace; these I trust, will be few in number; for it is burdensome taxes that occasion popular discontents. To this Spartan advice, a million of objections may be raised, but I dare venture to say, that nothing short of such a sacrifice can save this nation, surrounded as we are by an abandoned race of men, who are upon the watch to place us in a situation ten times more grievous than what my proposals would occasion. After all, will not my sumptuary plan by making us rich, be in the end productive of the same

mischief that I am now endeavouring to remove? It certainly would; but then we must have recourse to the same internal means to remove it, and not suffer it to be done by others; which will assuredly be the case if we do not do it ourselves. For want of following a plan similar to this, all the great empires fell; but, by my scheme, a nation is incapable of destruction, having within itself a power something like the seasons of the year. A sharp winter checks the prodigality of summer, and secures to the best parts of the world an annual renovation, which, under such circumstances, I expect will continue for a period beyond all calculation. From the vegetable, let the animal world take an instructive lesson.

Some of the wisest men in this kingdom seem to entertain an opinion, that we should be more happy in the character of shepherds and husbandmen, renouncing all colonial intercourse. But to the latter part of the opinion, I have a powerful objection, as it would be the means of destroying our navy, which I consider as the only power, under Providence, capable of protecting a nation of peasantry and manufacturers against the in-

sults of foreign powers. Let me not be viewed as one desirous of levelling all distinctions of men. I revere the glorious fabric of our constitution, and lay my finger only on our manners. A peer may superintend his farm, and still be a peer. The seeds of what I desire are already planted in the heart of our Sovereign, and nothing is wanting to accomplish this glorious change but a willingneſs on the part of his subjects. The greatest and wisest of the Romans did not disdain with their own hands to cultivate their fields; these, we know, were the happiest days for Rome, and that they may be so for Britain, let all the people say Amen.

ESSAY XII.

Experiments and concise Agricultural Observations.

1. *A Caution to Young Farmers**.

THE young farmer ought to be extremely cautious how he adopts the advice of such farmers as may have been bred in districts at a great distance from his own, as he may ruin himself (particularly in stock) by pursuing practices unsuitable to his lands and climate. The hints of the sensible men in his own neighbourhood, ought to be listened to with attention; but an observing eye, and an unremitting attention to such facts as may occur to himself, are the only sure guides to conduct him through the labyrinths of his profession. As to chymistry, it is certainly useful to those who rank in the higher order of agriculturists, but the young farmer ought to avoid its fascination, as it will only serve to make him a pedant in farming.

* By A. Hunter, M. D.

2. *On Soiling**.

In this place I introduce soiling merely as a means of raising dung, in which respect too much cannot be said in praise of it. It consists in confining horses, oxen, cows, and young cattle to stables or yards well littered, and giving them winter and summer tares, lucern, clover, rye-grafs, sainfoin, or common grafs, mown fresh every day, in racks, or cribs. The yards or pens should for this purpose be prepared; and if they are not covered with the dung of the preceding winter's foddering, they should be covered well with earth or marl, and littered upon. All sorts of cattle thus fed, make so much urine, that the stratum of marl or earth is indispensable, and should be laid thick. Lucern being a perennial plant, and bearing many cuttings, answers particularly well for this management in all places where the land is suitable.

3. *On Night Soil*†.

Here I shall only consider the farmer's conduct at his own home, where his great object is to raise as much manure as poſsible, with-

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* By Mr. Henry Jones. † By A. Hunter, M. D.

out being obliged to depend on purchases, which are only to be made in certain situations. If the farmer manages his neceſsary-house in such a manner as to suffer nothing to run from it, and frequently throws weeds, the refuse of the garden, saw-dust, ashes, or any kind of earth into it, he may, from a moderate family, every year, manure from one to two acres of land. It is a great neglect in most farmers to suffer much of this to be wasted, by allowing the chamber-pots to be emptied any where but where they ought. These things may appear to be trifles, but in a large family they are by no means such. Kempher, in his History of Japan, tells us, that the Japanese erect houses of office in all their highways, for the benefit of obtaining this kind of manure; and it would be a good speculation for the farmer to imitate this practice in all the manufacturing towns of this kingdom. It will not be going much astray from the present subject, to lay it down as a maxim, that all animal substances whatever, make admirable manures, much better than any thing in the vegetable or foſsil kingdoms; and this should not only direct the young farmer in the purchase of his manures, but also occasion him to be attentive to the waste of such substances

in his own house and farm; for all such substances, the compost dunghill should be the general repository. To the disgrace of this branch of agriculture, how often do we observe the carcases of dead sheep, horses, dogs, &c. lying exposed in the highways, instead of being carefully cut up and conveyed to the compost dunghill. A common snail may be the means of adding six ears of corn to the general granary, and under this speculative idea, how much may be expected from the carcaſs of a dead horse, or a sheep.

4. *On Compost**.

FARMS that have an easy acceſs to lime and peat-moſs, can always have plenty of manure. By compounding these in proper proportions, and adding, at a proper time, a certain quantity of dung, excellent manure may be formed: the effect of the lime and the dung being to perfect the putrefaction of the vegetable substances, of which the moſs is composed.

The lime and moſs ought to be in the proportion of one cart-load of the former to five

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* By John Thompson, D. D.

of the latter, and the dung one-fourth of the original compound. When the lime and moſs are mixed, the moſs ought to be tolerably dry, and the lime newly slaked and hot. This mixture, after it has lain three or four months, should be turned over; and in five or six months after, turned a second time. At this second turning, the dung ought to be added. After having received the dung, the heap should not be above three weeks before it be laid upon the land. In some cases, the natural qualities of the composition may require it to be thrice turned, and to be twelve months before it be used. Thirty cubical yards of this composition, per acre, will be a sufficient dreſsing for turnips, and forty for wheat. *It may here be observed, that the above compost is formed upon the simplest principle, but according to circumstances it may be made subject to variations, such as the addition of fern, rushes with their roots, and leaves of all kinds, upon all which, the hot lime will act with caustic vigour.*

5. *A humane and meritorious method of extending the breed of pigs*.*

I LEND to the wives of those who rent small

* By William Walcot, jun. Esq.

cottages of me, as also to the wives of the labourers about me, to each of them a well-grown sow pig, the value of all the produce from which is to be considered as entirely their own, and to be laid out in frippery or neceſsaries for the family as they may think fit; and when the sows have, under the care of these women, produced two litters of pigs, I relinquish all right to them, and they become the property of the women, who may, if they please, sell them and their last produce of pigs together. By this measure, I hope to counteract the very mischievous practices of the jobbers or dealers in hogs, who, for the expreſs purpose of keeping them scarce and dear, get into their hands all the sows they can purchase, and take every means to prevent their propagation: And for *this*, the reason is obvious, as every man (of that description at least) is actuated by his individual interest: thus, suppose a person in that buſineſs to employ a capital of 200 l. it is obviously his interest that it should be vested in one hundred rather than in two hundred hogs, as the provision for one hundred would be saved to him, besides considerable trouble and various expenses attending them.

6. *On the Eſsex Hoe* *.

THE Eſsex hoes are strong and maſsy. The wheat hoe is $6\frac{1}{2}$ inches long, and 3 inches broad; the edge stands about 6 inches from the handle. The bean hoe is $6\frac{1}{4}$ inches long, and $4\frac{1}{4}$ broad, and stands out in the same manner. The hoe is made very thick, heavy in the eye, and for a considerable way down. Hence the very weight of the instrument falling upon the weeds has more effect than the common hoes with the common strength applied to them.

Another very important circumstance to be observed is, that the labourers are never suffered to use this instrument in any other state than when properly sharpened or ground, for which purpose most of the farmers have a grind-stone fixed on their premises. By these means the hoeing in Eſsex is certainly effected in a most superior manner, as the land is not only kept clean from weeds, but is stirred such a depth that is nearly equal to a slight ploughing:

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* By A. Young, Esq.

7. *On Hoeing and Weeding in the County of Essex* *.

THERE is no part of husbandry more to be admired than the attention paid by the farmers to the keeping their land clean. The expense of hoeing wheat differs much. In some soils it costs from 4s. to 5 s. per acre, and in others 7 s. Wheat is sometimes twice hoed, and they hand-hoe even broadcast wheat, a practice quite unknown in many other places, though extremely beneficial. Hoeing wheat is found of the greatest use, in cutting up noxious weeds, in loosening the surface of the soil, in giving fresh vigour to the roots, and in earthing up the plants. In general, beans are hoed three times, at an expense of 4 s. 8 d. each time, and sometimes just before harvest they are again *looked* over by the day, or should the season prove so wet that they cannot well be cleaned before harvest, the stubble is then clean hand-hoed, and the weeds, &c. cleaned away before the wheat is is sown. By this mode, though expensive, the land is left as clean for the reception of the wheat, as if it were a well-made fallow, particularly after being hoed as above described.

* By A. Young, Esq.

8. *On the Management of Head-Lands* *.

It is well known that the head-land, and that piece of land lying between the head-land and the hedge, is generally lighter than the rest of the field, in consequence of the soil collected by the plough being scraped off and there left at every turning. A great deal of excellent soil is thus unneceſsarily accumulated, the height of which prevents the water from getting off into the ditch. Intelligent farmers are led to dig up this piece of land in the winter, or early in the spring, and as soon as the land has become dry, and the farmer has leisure, the manure is carted from the stable and yards and laid upon it. The soil and manure being well incorporated, it becomes a rich and cheap compost. At the same time, the moisture which comes from the dung, neceſsarily makes the head-land as good, or better, than any other part of the field. By this mode, brambles, nettles, docks, and other destructive weeds, which are apt to spread a considerable distance from the hedge, are neatly and correctly eradicated.

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* By A. Hunter, M. D.

9. *The Marks of a good Cow* *.

THESE are the marks of a good cow: wide horns, a thin head and neck, dewlap large, full breast, broad back, large deep belly; the udder capacious, but not too fleshy; the milk veins prominent, and the bag tending far behind; teats long and large, buttocks broad and fleshy, tail long and pliable, legs proportionable to the size of the carcase, and the joints short. To these outward marks may be added a gentle disposition, a temper free from vicious tricks, and perfectly manageable on every occasion. On the other hand, a cow with a thick head and short neck, prominent back bone, slender chested, belly tucked up, small udder or a fleshy bag, short teats, and thin buttocked, is to be avoided as totally unfit for the purposes either of the dairyman, the suckler, or the grazier.

10. *On Milk* †.

IT may in general be remarked, that the milk which comes first from the cow when milked is much more strongly impregnated

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* By Mr. Bannister.

† By James Anderson, LL. D.

with any peculiar flavour than what comes last; and as that is the thinnest and least valuable part of the milk, it may be taken away and applied to any inferior domestic use, without diminishing, in any sensible degree, the products of the dairy.

By thus separating the first from the last drawn milk, the quality of the butter will at all times, be much improved, and the quantity hardly diminished in any sensible degree. For I have found, by experiment, that a small quantity of milk, which comes the last from the cow, contains about sixteen times more cream than an equal quantity that comes the first at once milking, and that the cream is also of a much richer quality; the colour of the one being of a deep orange, while that of the other is as white as paper.

Hence we may infer, by way of corollary, that no method of rearing calves can be so beneficial for a dairy, as that usually practised in the Highlands of Scotland, where it is the universal custom to allow the calf to suck its mother for some time, and to drive it away, and milk what remains in the cows udder. By this means, the expense of milking is much

abridged—the calves are suckled more kindly than by the hand—and the quantity of butter not much diminished: But the greatest advantage is, that the butter is thus rendered of the finest quality that could posibly be desired. It has, indeed, been often remarked, that well-made Highland butter is of the finest quality that can any where be found; but this circumstance, which contributes so much to its perfection, has, I believe, been over-looked.—It is commonly imagined, that the butter which is of the deepest yellow colour, is also the richest in taste: And although it seems probable that this may be in general the case, and that many of the plants that answer the one of these intentions may answer the other purpose also, yet it is by no means certain that these are not sometimes disjoined. For I have often met with butter of a very rich flavour, with little colour, and the reverse; so that it would be of consequence to the farmer to have a list of the plants posesing these two qualities, separately made out.

It is a vulgar prejudice, founded upon very inaccurate observations, that plants which produce yellow flowers, in general tinge the

butter with their own colour; than which hardly any opinion can be so absurd. Yet upon no better foundation rests the general prejudice in favour of pastures that abound with the butter-flower, *(Ranunculus repens bulbosus)* which has evidently derived its name from that circumstance; although more accurate observations show, that so far is it from being beneficial to cows, that they refuse to taste the plant till they are reduced to the greatest distress by hunger. It has been often remarked, that if milk be of a very thick consistence, the cream is not so perfectly separated from it, as if it were thinner; that is, if water be added to it, more cream will be separated from it, than if it had got no mixture. But in that case, both the butter, cream, and whey, are poorer in quality, than if it had not been mixed: and as milk, naturally thin, is nearly in the same state as thick milk mixed with water, it seems probable, that if any plant tends to render the milk thicker, it will not afford an additional quantity of cream proportioned to the richness of the milk. But if this rich milk is converted into cheese, we may expect that it would afford a greater proportion of curd, and that of a richer quality.

11. *On sowing Turnips among Beans* *.

To sow turnips among beans in April is a custom frequently practised in Kent; and if the land be in good heart, they do often produce a crop worth the hoeing, when the beans are carried off the ground in September; or if not, the farmer will be poſſeſsed of some sheep-feed in autumn, when it may be much wanted, and that at a trifling expense; the same field may be sown with wheat when the turnips are fed off, with this additional advantage, that the ground will have been improved by the dung and stale of the sheep.

☞ *This method of raising turnips among broadcast beans has not much to recommend it, as the cloſeneſs of the beans will prevent the turnips from forming a bulb; but when both crops are judiciously drilled, there is a probability of advantageously obtaining a double crop.* *A. H.*

12. *On Harrowing* *.

In the County of Somerset this operation is performed with two harrows, and two horses a-breast, a lad being mounted on the near horse.

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* By Mr. Bannister.

† By John Billingsley, Esq.

The horses are kept to a *full trot*, by which one turn of the harrow pulverizes the soil as much as three or four in the common sauntering method.

13. *Expenses and Profit of sixty Acres of Grass Land. Dairy-Farm. Twenty Cows*.*

DEBTOR.

	£.	s.	d.
To rent of sixty acres, at 30 s. per acre	90	0	0
To tythe and taxes	20	0	0
To the labour of the family serving cattle, utensils, salt, and other articles, 30 s. per cow	30	0	0
To hay-making, &c. twenty acres	10	0	0
To manure	10	0	0
To repair of fences	2	0	0
To accidents with cows	10	0	0
To interest of capital	10	0	0
	182	0	0

CREDITOR.

	£.	s.	d.
By 70 cwt. of cheese, at 2 l. 10 s. per cwt.	175	0	0
By butter	20	0	0
By calves	20	0	0
By hogs	30	0	0
Creditor	245	0	0
Debtor	182	0	0
Profit £	63	0	0

* By John Billingsley, Esq.

Though it is not generally practised, a *breeding* stock of hogs must be considered as more profitable upon a dairy farm than a *fatting* stock. The whey and skimmed milk constitute a food well adapted to the rearing of a thriving stock; and it is well known that there are many instances of a farmer selling, at six months old, a litter of pigs for more than thirty pounds; and this done from the whey, &c. of ten cows, and without the assistance of corn, any further than the run of the farm-yard.

The expenses and profits of a *corn* farm, or a farm in *mixed husbandry*, are so variable, that it would be difficult to fix a standard. The old idea of the produce amounting to *three rents* would not *now* do, for the expenses of living, of taxes, of wages, &c. are of late years so much increased, that the value of the produce must be augmented in proportion.

One remark, however, may be made, namely, that it is universally admitted by all stewards, that *dairy* farmers pay their rents more punctually than *corn* farmers.

14. *On Public Scavengers* *.

It would be of public utility if scavengers were appointed in every great town, not only on account of keeping the streets clean from putrescent substances, but also on account of collecting large quantities of manure for the use of the farmer. In the city of London there are 3000 acres of pavement, in streets and market-places, the sweeping of which, together with the dung of 30,000 horses, 3000 cows, and what is produced by 800,000 inhabitants, cannot be calculated at leſs then 500,000 cart loads, which at two shillings per load, will amount to the sum of 50,000 l. per annum. This calculation, *mutatis mutandis*, may be extended to every town of note in the kingdom. It is to be lamented, that much of the soil of privies is lost to the public by the kennels and covered sewers that deliver their contents into contiguous rivers, but which, in many places, might be preserved.

15. *On Couch Graſs* †.

A SPECULATION.

This kind of graſs, which is so troublesome

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* By A. Hunter, M. D.

† By A. Hunter, M. D.

to the farmer, may, with proper attention, be rendered very useful. Hogs, and I believe all kinds of cattle, will eat it greedily in its green state, and when dried it makes a very nourishing hay. From its succulency, it is a long time before it can be sufficiently dried, but it has the peculiar property of abiding the weather for a great length of time. It is a doubt with me whether it would not pay for the expense of kiln drying, as preparatory to being ground into powder, or bruised, to be mixed with bean-meal for hogs.

16. *On Water Meadows* *.

THE best water meadow is probably the mark of perfection in the management of a farm. It follows, of course, that every possible exertion of labour, art, and machinery, should be employed to flow as much land as possible. Forty acres of good water-meadow will support, in the greatest luxuriance, 500 Wiltshire ewes and lambs for six weeks, from the middle of March to the 1st of May, during which time they will improve one shilling a week, or pay three pounds fifteen shillings per acre, at a time of the year when

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* By John Middleton, Esq.

all other farmers are distreſsed from a want of food for their stock. With other appropriation, the water-meadow would still be more valuable, as four or five pounds worth of hay might be mown off it as early as the month of May. What an encouragement is here held out to the farmers in the northern counties of this kingdom.

17. *A profitable Method of managing four Acres of a deep Loamy Soil* *.

In a field containing four acres, I first grew a crop of turnips, which were well hoed, and left very free from weeds; they were afterwards fed upon the land, which was immediately (the beginning of March) manured with ten loads of dung, first ploughed in with a common plough, and afterwards trench-ploughed about fifteen inches deep; two acres of which were harrowed very fine, and carrot-seed sown about the middle of March (though in general I prefer sowing towards the latter end of that month, as I have always observed the plants come up nearly as soon as the earlier sown, and attended with fewer weeds). The carrots came up regularly and

* By John Bertram, Esq.

well, were ready to hoe the beginning of May, and were tolerably free from weeds; so free indeed that they were hoed out with large hoes, and proved an excellent crop. The other two acres were prepared by ploughing and manuring as for the carrots, and set with potatoes, which came up very clean, and proved an abundant crop. In the succeeding year I grew one acre of carrots (with the former preparations) on the land where the potatoes grew, and one acre of potatoes where the carrots had grown; the other two acres were turnips. Ever since, for ten years, this field has grown turnips, carrots, and potatoes, in the rotation above mentioned. The carrots and potatoes coming upon the same ground only once in three years, the turnips every other year, the land has thereby become so clear of weeds, and so rich, that my crops are annually better, and the expense of hoeing lessened at least one half. The expense of this mode of cultivation, together with the application of the respective crops, is well known to every farmer. Whoever raises the most money from a given quantity of land, is the best farmer, provided the land be left in good heart and vigour.

18. *On Paring and Burning.*

I AM confirmed, in my opinion, that nothing is equal to paring and burning for the improvement of waste lands. It has been asserted, with confidence, that this operation is losing soil in the air. This is an assertion plausible in theory only; experience, I am persuaded, is against it; the bad management of the succeeding crops, and the frequent repetition of corn, injure the land, and not the operation of burning. I will venture to assert, that I have a greater depth of soil, where I pared and burnt, than I had before. Any person following the plough, as it breaks up the wheat stubble, would agree with me in opinion. In my parish of Enfield, it turns up a loose black garden mould of considerable depth; this, I apprehend, is easily accounted for, by attending to the action of burnt clay, as a mechanical manure, which, when ploughed into stiff land, breaks its adhesion, and aided by the vegetable ashes, converts it into good loam. Fire and water are of more consequence in raising manure than farmers in general have as yet viewed them. Not being

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* By A. Wilkinson, M. D.

able to procure hands for paring and burning part of my spare land, I ploughed and croſs-ploughed the turf, and then burnt it for manure with ſucceſs, Burning the turf ſecures the crop from that injury from the worm, to which, on fresh land, it is so much exposed.

19. *On the Management of Wheat in the Shock* *.

If the weather be tolerably good at the time of cutting the wheat, set the sheaves up naked, and in that state let them remain until the ears be opened, the chaff loosened, and the grain mellowed; and then, if the weather be hazardous, cover them up until the butts be thoroughly cured. It is observable that the sheaves should be set up north and south, not east and west; for in this case, the sheaves on the north side are several days later, in respect to fitneſs of carrying, than those of the south side.

20. *On Salting Hay* †.

I am persuaded few farmers are aware of the benefit of salting hay. The salt preserves

* By Mr. Marshall.

† By Mr. T. Bernard.

the hay from over-heating and becoming mildewed; it may be put together greener than otherwise, without danger of firing. All kinds of cattle prefer inferior hay, thus managed, to the best that can be placed before them that has not been salted. The proper method of using it is, in building the stack, to sprinkle the salt alternately between each layer of hay, in the proportion of one hundred weight to seven or eight tons.

21. *On Steaming Potatoes and Turnips*.*

For this purpose there is an excellent apparatus fitted up at Woburn. A veſsel, containing near a hogshead, turns on central pivots; a pierced bottom lets in the steam, the barrel turning on and off the copper (of 20 gallons) at pleasure; fitting on to the rim of the copper in a groove, secured by a wet rope around it. The contents are steamed in an hour and twenty minutes after the first heating. Potatoes were found thus to answer for hogs moderately; and for cows, steamed turnips being added to hay, they ate but little of the latter, the milk and cream much increased,

* By Mr. Clayton.

and tasted leſs than when the turnips were eaten raw.

22. On Sheep, as to Buying and Selling.*

At fairs it is usual for the sheep to be penned very close within hurdles. I have often observed good judges deceived, when in such a case they attempted to draw off a lot upon buying on condition of choosing any out of a great number; or of throwing back a portion of the worst. They stand so crowded that no good judgment can be formed; it is better, in this case, to have a pen enlarged by the addition of a few hurdles, so as to view the sheep well.

In selling sheep, in a common state of fatneſs, there is an unerring rule, by which the unexperienced farmer is upon a par with the oldest salesman or butcher. Weigh the sheep alive, and half the groſs weight, with from one to five pounds added to it, is the dead profitable weight; call it therefore half, and the seller is secure, and knows that he cannot suffer in the sale. He should have a cage made with a door at each end, into which he puts the

* By A. Young, Esq.

sheep, and weighs them, or hogs, with great expedition. Lord Kaims found the two sides to be half, skin the eleventh, tallow the tenth, and offal the rest, or somewhat leſs than the third part.

23. *On the Qualifications of a Shepherd*.*

A GOOD shepherd is so eſsential in the management of a flock, that it is in vain to expect the full profit which this animal is capable of yielding, without it. Great numbers of little farmers, who keep but few sheep, of course cannot afford this servant; the single man, kept by such, has many sorts of work to execute, and all sorts of cattle to take care of; the consequence of which is, the sheep are often neglected. The expense of a shepherd is considerable, so that the flock must be large to pay his wages, and keeping sheep are never in any instance managed to their full advantage without one person constantly to attend them. A flock of this nature, in the common management, is folded through a great part of the year; this is a regular buſineſs twice every day. In the lambing season, a careful eye should always be upon them; and add to

* By A. Young, Esq.

these points the numerous distempers to which they are subject, and it will appear evidently clear, that this servant is indispensably necessary. But, as the expense of him will, upon an average, in pay and perquisites, amount to 30l. a year, and in some places more, it is neceſsary to give him as many sheep as he can properly take care of; with a breeding stock, this may be 1000. I have known 1500; but with a thousand he may at lambing time want some aſsistance. Upon the South Downs they reckon 800 ewes enough for a man, reckoning his expense 30l. and the number of the flock 1000, it is about 7d. a head; extra attendance in lambing may make it 8d. This is a very trifling expense in comparison with the advantages resulting from it. But when a shepherd is kept to two or three hundred, being more than doubled, it becomes an object, and cuts too deep into the profit. The way of paying shepherds is various; in some counties they have a portion of the flock: for instance, 100 ewes, and their produce, which appears to be a very large allowance: in others, from 20l. to 30l. a year, and the keeping of from five to ten sheep. But upon a general average we may reckon 30l. a-year about the expense: this is 1s. a head on 600

sheep, which may be supported; but 2s. a head on 300, is too heavy to be afforded with profit.

The shepherd's business is to manage and execute every thing that has any relation to the flock: he attends them out with his dog the whole day through; lets them out of the fold in the morning, as soon as the heavy fogs or dews are dissipated; shifts the hurdles for a new fold; folds them at night; and in lambing season must be up sometimes all night, if he observes several ewes that appear to be near lambing, but with difficulty. Good shepherds in very heavy rains get up and let their flocks out of the fold, where the soil is not perfectly dry. In a word, his care and attention to his flock to keep them in health, and free from accidents and distempers, must be unremitted and indefatigable. With us, it is customary for the shepherd to follow the sheep, but in the Scriptures we are told, that the sheep followed the shepherd.—*John* x. 4.

24. *On driving Sheep to fold* *.

This is an article which must always be

* By A. Young, Esq.

considered in folding sheep; for if the walk, or common, be too far distant from the fold where they are folded, the sheep will lose more than to the amount of the value of the manure. In general, it must be observed, that a fatting stock, even in its early period, must be driven a very little distance, not more than a quarter or half a mile; and for a breeding flock, if the distance is above a mile, they will suffer, unleſs it is *walk* all the way, and they are moved gently, feeding all the time; gravel roads and lanes are exceeding bad to drive sheep through, as they are apt to give them disorders in their feet. If a common, or walk, is a mile off, and such a way to it, I should prefer a standing littered fold on or near it, rather than drive to so much hazard of the sheep. In this article, and the not hurrying the flock, a good shepherd is of the greatest consequence. Sheep are in many parts let out to fold for hire, and the price usually is 1s. per week, per score. In Norfolk and Suffolk they value the fold at 1s. to 1s. 6d. a head, per annum. By the standing fold, in the course of the winter only, I make a ton of manure by every sheep, which (expenses deducting) will for that half year only, amount to more money. The value of

the dung in both cases, will depend on the goodneſs of the food. Let it be remembered, that before the sheep are let out of any fold, the shepherd should go in and disturb the flock, in order to induce them to stale and dung, which they do on first rising.

It is reckoned that lambs are the worse on account of common folding by 1s. in 12. This is probably owing to bad weather in the night, when they are prevented from getting to shelter. I never saw finer lambs than I have had in the covered fold: I firmly believe the finer on account of that practice.

25. *On Pastures**.

I OBSERVE no stated time of turning into the pasture, being governed in this respect wholly by the season. Every fortnight I send my boy with a shovel and wheelbarrow to take up the dung, which is put on a heap, and covered with earth or ashes, as I think nothing encourages and promotes the rank and strong tufts of graſs, which take up a great part of most pastures here, and which the cattle will not touch, more than the negligent and too

* By Mr. William Stow.

common practice of suffering the dung to remain on the ground: by a strict adherence to the above method of taking up the dung, my pasture becomes one entire bed of level grafs. In a few weeks the grafs is grown on the places where the dung was laid, and not a vestige of the dung to be seen; but in these pastures where the above is not practised, I usually find a great part of the pastures incommoded with numerous tufts of rank grafs, and a great quantity of dung, especially towards Michaelmas, when the pastures begin to fail; and this, in fact, is to diminish or take nearly an eighth of the size of such pastures; not to mention the very great difference of the dung, both in point of quantity and quality.

26. *On the speediest method of diffusing Agricultural knowledge* *.

It must be manifest to every superficial observer, that the most convincing and self-evident improvement, may be practised in one parish for years, and never be heard of in another at ten miles distance. I should therefore strongly recommend to every nobleman

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* By the Rev. H. J. Close.

or gentleman of large landed property, the following plan. Let those, who have estates in the counties where the management and improvement of grafs-lands, and of stock, are well understood, take one tenant from the counties of Suffolk and Norfolk, where the farmers are almost a century before many other counties, in the management of arable lands, and place him on a farm in a centrical part of his property, observing to transplant him from a soil somewhat similar to that which he is to enter upon. If strong loams, or clays, he should be sought for in what is called high Suffolk, or from similar soils in Norfolk. If gravels, or light lands, he should come from, what are deemed in those counties, the sand-lands This would introduce a much lefs expensive mode of cultivating the lands, and a more judicious mode of cropping into many counties of England. But though I give to the counties of Suffolk and Norfolk the most decided superiority in the management of lands, under tillage; yet I am of opinion, that the farmers in those counties, are not lefs ignorant in the management of stock, and in the improvement of meadow and pasture lands, by irrigation, and other judicious modes, than other counties are inferior to them in tilling and cropping the

arable lands. Land-owners in those counties, would facilitate the improvement of their property, by adopting similar measures, and transplanting into each district a few tenants, from situations where the management of stock, and the improvement of meadow and pasture lands are better understood.

27. *On feeding Turnips on the Land, or carting them to Sheds*.*

Born and educated in Suffolk, where almost all the turnips are fed upon the land, I naturally adopted the same plan. Experience has since convinced me, that though the Suffolk farmers may know how to grow good turnips, they have yet to learn how to make a proper use of them. The objections to this system are evident. A large proportion of the turnip crop is wasted by the cattle. The manure is not only very unequally and promiscuously left on the land, but by far the greatest part of it is dropped, or washed into the furrows, and carried off by the rains; and winter feeding in this climate, without any shelter from the vicifsitudes of the weather, must, in some

* By the Rev. H. J. Close.

degree, injure the cattle. The only objection to carting the green vegetables home to sheds, both in winter and summer, is the additional labour and expense; but these are paid for in a ten-fold degree by the increased value of the food, the thriving of the cattle, the making the dung under cover, and having reservoirs to catch the urine. With this management, one good acre of turnips will produce an excellent dreſsing for an acre and a half of land, and will completely winter-fat an ox of fifty score. If fed on the land, two acres may fat an ox, but not so well, and the dreſsing will be very partial and precarious.

I shall here give the average money price of an acre of turnips, to be fed on the land in Suffolk, and then state the profit, not of one acre, but of all the turnips on a farm when carted into sheds. Forty shillings an acre is a high price for turnips in Suffolk; but as they are fed in that county, very commonly, by the stock of graziers, who have no land, we must value the manure left on the field, though in a most slovenly way, at thirty shillings more. Now I have frequently cleared ten pounds ten shillings per acre by my turnip crop, when used in sheds; and a

neighbour of mine, who farms on a large scale, cleared this sum on his turnip crop the last year; and the quantity of the very best manure raised from such an acre of turnips so managed, will amount to twenty tons, worth five shillings per ton. These observations apply to horses, and cattle of all sorts, sheep excepted. How far it will be practicable or eligible to house these useful animals, I cannot presume to say; but certainly they thrive best when they lodge dry. Horses, bullocks, cows, &c. of all sorts should, in my opinion, be under sheds, winter and summer, except a few hours in the day time in winter, or a few hours in the evening, or at night in summer. One acre of grafs, clover, lucern, or vetches, cut and carted to the sheds, will support three times as many cattle, in better order than the same acre when fed in the common way. The waste in this mode must be great, from the trampling of the cattle; and on pasture lands, they will naturally pick the most palatable grafses first, and leave the others to run up to bents. No mixture of cattle can prevent this; for though one sort may prefer one species of grafs, and another another, it is altogether impofsible so to proportion each species of cattle, to the species

of grafs most palatable to it, as to prevent a scarcity of one sort, and an abundance of the other. It must also be observed, that when there is a mixture of cattle, they frequently interrupt each other and do not thrive. By stalling, all the green food is eaten, and no part of it wasted. The cattle fill themselves in half the time, and consequently have more hours for rest. They cannot interrupt each other. The dung made under cover is not only much stronger, and in much larger quantities, but can be applied to any part of the farm, instead of being almost entirely lost, as when dropped on the pastures. The cattle are never liable to kick each other, or to be damaged by breaking pasture; and it will never be neceſsary for a ploughman to lose a day's work, searching the adjoining fields or parishes for his horses. These experiments and arguments, will, I trust, appear conclusive as to the best mode of applying green vegetable food both in summer and winter: For my horses, I have erected cheap thatched sheds, in which they have room to walk and to roll, and in these they go winter and summer; to which I attribute it, that they are not so liable to colds as those kept in a hot stable, and are never cracked or greasy-

healed. For my bullocks and cows, my stalls are seven feet wide, each stall holding two head of cattle, each fastened by the neck close to the side of the stall, to prevent their interfering with each other with their horns.

28. *On Ribband Grafs**.

A SPECULATION.

THIS is a species of grafs usually cultivated in gardens for variety and ornament. When green, it is eaten by horses, and I apprehend that when made into hay it will prove equally agreeable. It ripens about a fortnight before the meadows are fit to cut, and it has the appearance of producing a heavy crop. It delights in a moist soil, and is a perennial plant.

29. *On the Dibbling Husbandry**.

I CANNOT sufficiently expatiate on the excellence and importance of the dibbling husbandry. It saves two pecks of seed per acre, which is a considerable object in a whole kingdom; it gives a second harvest to the

* By A. Hunter, M. D.

† By the Rev. A. Young.

poor in wheat sowing; and a third in oats; and it is universally, on any fair average, attended with an increase of crop of from two to six bushels an acre: view this practice in any light, and it will be found highly deserving of particular attention and encouragement. A man and his wife and six children will earn five, six, and seven guineas at wheat dibbling; and as much more by oats, and pease, and beans. No crop should be put in on a flag, or layer, or on unbroken earth, in any other manner. It far exceeds drilling; which, however, is a commendable practice in many cases.

30. *An old Sheep-Pasture not convertible into Meadow* *.

After a field has been long pastured with sheep, and close fed, it becomes unable to yield a large growth of hay: the plants by being constantly cropped down, acquire a dwarfish habit. There is a field on this estate which has been under grafs time immemorial, and kept fed for the last forty years at least, exeept one year in which it was mown, expecting a vast crop: the season was very fa-

* By the Rev. A. Young.

vourable, but I was utterly disappointed, for the produce was small. I have known the same thing happen on inclosing an old common. In Scotland a similar remark has been made. "Two inclosures of the same soil were laid down together with grafs-seeds of the same kind: after two years hay, the one was surrendered to pasture: from the other a crop of hay was taken every other year. After an absence of seven years, the proprietor returned home; and wanting more hay, mowed both fields, and that which had been pastured, gave the worst crop.

31. *On repairing new laid Land**.

It often happens that two or three kinds of the seeds sown do not vegetate, in which case the field may be repaired by re-sowing the deficient seeds in the spring, when the weather is moist. And as the harrow cannot at this time be well introduced, a large fold (five or six yards to a sheep) may advantageously be run over the field, the seeds being sown before the sheep enter. This method will effectually thicken a new lay that has suffered from abortive seeds.

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* By A. Hunter, M. D.

32. *A humane method of bringing waste lands into Cultivation**.

THE giving a cottage and a few acres of waste land, under a small reserved rent, and perhaps under other useful restrictions, to a poor man, is certainly a good way of improving the land. When a man has land of his own, he and his family will exert, in its cultivation, a quantity of labour which would not otherwise be brought into existence. The value of this, otherwise non-existing labour is, in one respect, nothing; it ought not to be reckoned as a part of the expense attending the improvement of the land; and, on that account, many thousands of acres of waste land might be brought into cultivation, which would not, in any other way, pay the expense of improvement.

33. *On the resources against a severe Winter and Spring* †.

FOR the support of great stocks of cattle and sheep during a severe season, there are three resources.

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* By the Bishop of Landaff.

† By A. Young, Esq.

1st, *Rowen*, or after-grafs. This provision is, perhaps, of all others, the most important: it costs next to nothing; bad weather never destroys it; it gives much milk, and may be kept to any period; for the young shoot springs under it so strongly, that when the surface seems dead and worthleſs, there will be found a treasure beneath. It demands no other attention than to adapt the season of training it up to the richneſs of the land: upon poor and indifferent up-lands it should be from the scythe, or middle of July; on richer lands, from the end of August; and from still better meadows, from September. When the growth before winter is too great, heavy snows are apt to spoil it, but with a proper attention to this point, never. I consider an acre of hay yielding a ton, and the Rowen of that acre, to be equal for sheep to an acre of turnips.

2d, *Swedish turnip*. No frost affects these roots, which are juicy and nourishing long after the shoots are far advanced for seed. The plant, however, demands rich land, or ample manuring; and none will pay better for either. The seed should be sown where it is to remain, from the beginning of May to

the middle of June, and set out in hoeing, as with turnips, at a distance proportioned to the fertility of the soil.

3d, *Stubble turnips.* I have not seen this branch of cultivation any where so well understood as in the vale of Taunton, where I found it commonly practised thirty years ago. Immediately on reaping the wheat, without waiting for the crop being carried, they plough the stubble, and harrow in turnip seed, setting the sheaves in rows upon the land thus tilled. These turnips, if the weather is tolerably favourable, will rise to the hoe; but without any hoeing, they prove exceedingly valuable late in the spring for sheep. No frosts affect such late sown crops.

These three articles, with hay moderately given, will secure any flock from the dreadful losses brought on by a severe winter and spring.

34. *On the Milk consumed in London**.

The cow-keepers in the neighbourhood of

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* By Mr. Thomas Baird.

London supply the retailers with milk, unadulterated, at the rate of three-farthings a pint, and those retail it to the inhabitants at three-halfpence. Though the yielding a great quantity of milk is naturally the principal quality wished for by the cow-keepers in the cows they purchase, yet so indifferently have they as yet succeeded in obtaining that object, that though it is well known that cows in Scotland, of the true Dutch breed, yield at the rate of sixteen Scotch pints, or eight English gallons per day, and sometimes more, yet in the neighbourhood of London, they seldom give more than six gallons even in the height of summer; indeed five gallons in summer, and four in winter, is a high enough average.

The account of each cow will then stand as follows:

	No. of gals.	*Value of milk.* £. s. d.
Five gallons per day, for 182 days, at 6d. per gallon	910	22 15 0
Four gallons per day, for 183 days, at 6d. per gallon	732	18 6 0
	1642	41 1 0

On the supposition that there are 6000 cows neceſsary for the supply of London and its suburbs, there are consequently 9,852,000 gallons of milk sold there in a year, or, on an average, about 27,046 gallons daily, for which the cow-keepers get 246,300l.; and as the retailers get 1s. per gallon, it costs the inhabitants of London 492,600l. per annum, or about 1350l. per day, to be supplied with milk and cream.

35. *On Tares**.

In Suſsex, arable lands, tolerably clean and in heart, or rendered sufficiently so with manure, are ploughed in September or October, and sown with winter tares, which are fed off in April and May with Sheep. The land is then ploughed, and spring tares are sown for sheep-feeding in autumn: in this manner two crops are gained, instead of an unproductive fallow. Upon ray-graſs and trefoil layers, instead of a bastard fallow, as in Norfolk, they sow spring tares and rape,—a bushel of tares and a gallon of rape; these are fed off in autumn with sheep. One acre and twenty-nine perches of such a crop have been

* By A. Young, Esq.

found sufficient for four hundred ewes for a week; which at 2d. is 3l. 6s. 8d.; the value of the fold 1l. 5s.; together 4l. 11s. 8d.

The whole range of British husbandry does not offer a more valuable instance of management than that which is here described. I may remark, that the same management is pursued when tares are used for soiling the teams in the stable. The winter sort are ready in May and June; and as fast as the land is cleaned it is ploughed, and instantly sown in regular succeſsion with the spring sort; by which means soiling goes on from June inclusive to November.

In Wiltshire, spring vetches are sown on the Downs in suceeſsion during the spring months, so as to come in at different times of the summer.

In Gloucestershire, vetches are sown for feeding sheep, which are put on them the latter end of May or beginning of June. They are commonly hurdled off in the same manner as turnips; but if a bulky crop, the better way is to give them through rack-hurdles, which are made the same as the com-

mon five-railed ones, only leaving the middle rail out, and nailing spars acrofs, at proper distances, to admit the sheep to put their heads through. A swarth of vetches being mown acrofs the land, a sufficient number of these hurdles, allowing one to five sheep, are set close to it. At noon the shepherd mows another swarth, and throws it to the hurdles; and the same at night. Next morning, the swarth being first mown, the hurdles are again set. In this way the vetches are clean eaten. As fast as cleared, the land is ploughed, and sown with turnips; sometimes with spring vetches. Too much cannot be said in praise of this admirable management: It is perfection.

36. *On Marl-grafs.*

In Somersetshire, marl-grafs *(trifolium alpestre)* is cultivated in the north-east district. This spontaneous production of marl-land, first collected fifty or sixty years ago, by a Mr. James, of Chilcompton, has become common, and is considered as a valuable substitute for red clover; it lasts much longer. Sow, 20lb. of it, and 7lb. of white Dutch.

37. *On Rape for Cattle.*

This crop is never cut and fed in the yard

or house. Whatever cattle eat it are turned judiciously into the field; consequently it is to be depended on only on soils that are dry, and will not poach; in this case it is a very profitable and useful crop; not to the exclusion of turnips and cabbages, but to succeed them in the spring, when these are rotten, or gone

38. *On Carrots and Potatoes.*

THERE is no winter food so good for cows as these roots; and where the crops are exceedingly plentiful, it may answer to give them by way of bait, but we must not suppose that any cow can pay for a constant and regular full meal of either.

39. *On Suckling.*

For a certain distance around the capital, dairies are leſs profitable than suckling, that is, fattening calves for the butcher, the year round. This is also leſs troublesome, and leſs subject to impositions, but is not at all applicable to the great body of the kingdom, and very rarely practised but in the neighbourhood, that is, within thirty or forty miles of very great cities. The cow-house for this purpose should be large and airy: a range of

ties on one side to fasten the cows, and one of cribs on the other for the calves. The house and cribs must, by cleaning and littering, be kept accurately clean, and free from ill smells, or the calves will not thrive well. The calves are brought in and suckled twice a day. Leather collars are buckled around the necks of the calves, by which they are tied in the cribs; and lines from the ceiling of the house are fastened, so that the calf may be tied in a moment to them, while they are suckling, to confine them to their right place. Without this precaution, the whole house would be a scene of confusion, and much aſsistance neceſsary; but by good management one man will completely attend fifteen or twenty cows. The cows while tied up, are fed in winter, spring, and autumn, with grains, cabbages, turnips, hay, soiling, &c. In this system, calves are constantly buying in, at ten days or a fortnight old, for 12 and 15s. to 20s. each, and kept to be worth from 40s. to five pounds, leaving a good profit. Cows that are suckled are seldom affected by the disease called the *garget*, which proceeds from not being clean milked. This complaint appears as a hard knot in the udder, and is often attended with the loſs of one or two of

the teats. When the disease is recent, it is a good way to have the cow sucked for some time, stroaking clean after the calf; but when long continued, it is the best way to dry the cow for fattening, rather than to attempt a cure.

40. *On Deep Ploughing**.

When first Lord Winchelsea engaged in farming, a person, who was then his bailiff, told him the land would not produce pease, beans, carrots, or potatoes; but not confiding in this information, his Lordship made an experiment of them on the common ploughing of three inches deep: the crops, as predicted, all failed. He then tried them again,—an acre of each, with trench-ploughing, and the produce of all the four was very great. The whole farm, from that time, has been ploughed deep, and his Lordship has every reason to believe, that, without a proper depth of tillage, the value of those rich red soils will not be discovered. This is a most important experiment, as it may be the means of inducing farmers to examine more minutely into the

* By A. Young, Esq.

depth of their arable lands. An inch of fresh soil added to what has been turned over for half a century, is of inestimable value.

41. *On Wheat Dibbled on a Clover Lay**.

A SPECULATION.

WHEAT dibbled on a clover lay is often destroyed by the wire-worm; and as lime is found to be inimical to worms and slugs with tender skins, would it not be a good preservative to strew some hot lime over the land immediately on its being dibbled? I know a farmer who gets good crops of wheat after ploughing in the second crop of clover, and giving the surface a slight dreſsing of lime newly slaked. The soil a tenacious clay. In countries remote from manure, this seems a rational system.

42. *On the Rot in Sheep*†.

THIS is the most dangerous disease to which sheep are subject, and perhaps the least understood. It is attributed in different parts of this kingdom to a thousand different causes, though

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* By A. Hunter, M. D.

† By A Young, Esq.

all, or most of them, are supposed to arise from a superabundant moisture in the ground.

No sheep ever rotted upon high, hilly, or rocky land; when a country is so uniformly dry that you may go some miles to find a spring or a river, no rot is ever found upon it; yet it is not moisture simply that rots, because some of the wettest soils never rot; nor does a a salt marsh, let it be as wet as may be; but, on the contrary, it cures the disease.

The circumstance of all wet lands, not rotting, laid the foundation of a theory amongst farmers, that it is owing either to a sudden growth of grafs occasioned by much wet, or elfe to certain plants which the animal finds in some wet places, namely, particularly the marsh penny-wort or white rot, *(Hydrocotyle Vulgaris)* and the butter wort *(Pinguicula Vulgaris)*. But there are strong reasons for believing this is an error, notwithstanding Hartlib mentions the disease as occasioned by the first named plant. If feeding on fresh luxuriant grafs, or on those plants, was the cause of the rot, one would naturally look for that effect more in the spring than in the autumn. But the contrary is the fact, as all

the poſſeſsors of watered meadows well know; for it is very remarkable, that no watered meadow rots by feeding it in the spring. This is so acknowledged a fact, that the common husbandry of those grounds is to depend on them for the spring food of sheep, by the men who know with equal certainty, that the same lands rot their flocks infallibly, if fed in autumn, before the watering of that season; a circumstance decisive to prove that it is not the young graſs which occasions the disease; and still more so, that it is not the feeding on any particular plant, especially such as flower in May, the case of the two above-named plants.

I am reduced to think with some Swedish Naturalists, that the distemper is totally owing to the *fluke*, or fish found in the hepatic and billiary ducts, and that the sheep lick up those insects in feeding on certain wet places. A strong confirmation of this idea is, that the *fluke* is found adhering both to stones and plants in some moist lands; it is called by Linnæus the *Fasciola Hepatica*. This animal, whose natural history is not sufficiently known, may not be produced in the spring. When the disease is discovered, or suspected,

the best remedy is to put the sheep immediately on very dry, sound, healthy land.

43. *On obtaining a vinous Spirit from Carrots* *.

THE production of spirit from grain being often prohibited by an act of the legislature, would it not be advisable to recommend carrots as a substitute for grain in making a vinous spirit? From some experiments which I have made, I am warranted to say, that eighteen tons of carrots will produce 100 gallons of a proof spirit equal in goodneſs to that which is obtained from grain.

I took one ton of carrots, which, after being topped and tailed, were well washed in warm water, and afterwards cut into pieces about three inches in length. In this state they were put into a copper, with a sufficient quantity of water, to prevent their being burnt. They were then covered up with cloths to confine the steam, and in a short time were reduced to a soft and pulpy state. When nearly cold, they were put into a common screw-preſs, and the juice extracted from them. This juice, when mixed with the liquor left in the copper, was boiled down as if intended

* By A. Hunter, M. D.

for ale; in taste, colour, and smell, it much resembled sweet wort. I need not describe the manner of conducting the fermentation of this liquor, nor the subsequent distillation, as those operations are well known to the makers of raw spirits. I presume that it would be a national benefit if this mode of producing an ardent spirit was permitted, paying a small duty, at the time when the distilleries are stopped. It would, in a great measure, prevent the large importation of foreign spirits.

It is probable that the parsnip, and the red beet, may be more productive of spirit than the root with which my experiments were made. An acre of carrots (18 tons) will produce considerably more spirit than an acre of barley, (estimated at 5 quarters) and leave a greater quantity of food for hogs, which is a material consideration to the distiller, as the refuse makes a considerable part of his profit.

44. *The most profitable Method of bringing Waste Land into Cultivation* *.

A SPECULATION.

TURNIPS are so useful an article in the improvement of waste land, that in many cases

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* By A. Hunter, M. D.

it may be advisable to take two crops of these in succeſsion, after paring and burning. This will reduce the land into a fine tilth, and render it in excellent condition for laying it down with seeds, either with or without a crop of corn, but better without corn. With this management, and a careful attention to the cleaning and manuring of the young quickwood, an uncultivated waste, may, in a few years, be made to put on the appearance of an old inclosure. A landlord who has spirit enough to give up the land to the farmer, rent free, for the first year, will, in the end, find his profit to overbalance his generosity. In following such a system, it will be unneceſsary to say, that the turnips must be eaten off with sheep; and to prevent their cropping the newly planted quickwood, they must be confined in the usual manner by nets or hurdles. To draw the turnips, would overturn the whole system.

45. *The bad Consequences of a Farmer's Leſsening his Capital by the Purchase of Land**.

THOSE who are fond of political calculations may have here full scope for their inge-

* By James Anderson, LL. D.

nuity, by supposing that two men of equal spirit, knowledge, and capital, set out in the agricultural line. One of them as a farmer, on a lease; and the other as a small proprietor, or yeoman. Let the capital be taken any how at random; say 2000l. The yeoman, we shall say, lays out 1500l. of that sum in the purchase of a farm, which, at thirty years purchase, would be worth 50l. a year, and he has 500l. left for stocking and improving it. The other leases a farm, which, at a fair rent, is worth 200l. a year. Let us follow out the calculation,—first, in regard to the profits that the different occupiers themselves can enjoy, and the rate at which their families can afford to live;—and, second, with regard to the augmentation of agricultural produce that each of them could afford to the state; and let this calculation be continued for a considerable number of years. Then strike the balance, and see what an amazing difference!

46. *The Collection of Tythe in kind, an improper Employment for a Clergyman*.*

THE collection of tythe in kind, is, of all

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* By James Anderson, LL. D.

employments, the most unbecoming the clerical character, more especially when it is considered, that every person concerned will feel himself disposed to pay it with reluctance, and will throw every obstruction in the way that he thinks will tend to render it disagreeable and troublesome. To avoid this heavy train of evils, most of the sober-minded, well-disposed, worthy men among the clergy, wish, at all events, to free themselves from it. If they attempt to draw the tythe themselves, unable to cope with those who are accustomed to transactions where cunning and chicanery are exercised to their utmost stretch, they are imposed on at all hands, and receive but a small proportion of what they have a legal title to. If they attempt to transfer their right to another, that person must be well paid for executing an office which is attended with so much trouble, and so many interferencies with his neighbours. Few, indeed, will undertake the task, unleſs it be persons of a turbulent disposition, who are disposed to grasp at all advantages; and who will not, perhaps, be very scrupulous at imposing upon the clergyman as readily as others, In this way, there is reason to believe, that a worthy clergyman of primitive simplicity of manners, does

not, in many cases, realize much more than one half of the sum he has a legal claim to exact. To *such* men, this mode of providing a living for them is perhaps among the worst that can be devised.

But if a person having a right to the tythes, be one of a turbulent disposition; one who is eager to grasp at all advantages; one who is regardless of the circumstances of others; one who is little scrupulous about the means he adopts for obtaining an ascendency over his neighbours; and who, laying aside the decorum becoming the clerical character, engages in a perpetual bustle and wrangling, determined to exact with the utmost rigour every *item* that the law authorises him to levy. The living that would be a poor one in the hands of the person of the former description, will be, to him, abundant; and he will live in affluence, while the family of the other is condemned to comparative poverty. In acting thus, however, he loses all influence in his clerical capacity. His practice belies the doctrines he is obliged to preach. He becomes detested and despised. In the performance of religious duties he is deserted: the morals of his parishioners are corrupted,

and the finest bonds of society are dissolved. He becomes a disgrace to the venerable body to which he belongs; and the whole order, because of his impropriety of conduct, falls into general disrespect. "Is it not a matter of much astonishment, that the clergy should so universally object to convert their tythes into money, as their refusal is the occasion of our holy religion receiving so many bitter wounds. Is it not consistent with justice to *compel* their acceptance, by the same authority that obliges a man to convert into money part of his landed property, for the purpose of a canal or a turnpike road!"

A. H.

47. *Beans preferable to a Fallow*.*

So long back as the year 1767, I entertained an idea, that the thick shade from a crop of beans in the height of summer would cause a putrid fermentation, open the land, loosen the soil, and, at the same time, from the nature of the vegetable being leguminous, would not exhaust it; for which reasons, I concluded they might be substituted instead of a fallow in my farm, the soil of which con-

* By the Rev. Mr. Fiske.

sisted of a thick wet loam. In March, that year, I mucked six acres of barley stubble, and set it with Windsor beans; the crop kept clean; the produce 48 coombs; 46 of which were sold to a gardener of Bury, for 18s. per coomb.

October following, the same field was sown with wheat; the produce rather better than six coombs per acre, which was more by a coomb per acre than I had that year from any clean fallow.

March, 1768, I set 16 acres of the small horse-bean, two rows upon a three feet ridge, upon an oat stubble, ploughed at Michaelmas, and mucked before the setting; the crop nine coombs per acre; wheat succeeded, which proved the best crop in the whole parish.

Being now fully convinced that the idea I had first formed was right, I determined to plant every field I occupied in rotation with beans, which I have done; and have often had ten, eleven, and once twelve coombs per acre, and never failed of getting a fair crop of wheat of six coombs an acre, on an average, after them.

In 1782, to prove the use of a bean culture as a preparation for barley, the following experiment was made in an eight-acre field; four acres of which were sown with turnips, two acres set with tick beans, (which in my opinion, yield in general the best crop) two acres a clean fallow; the beans kept clean. The turnips were hoed and fed off with sheep. The spring following, the whole field was sown with barley. That after beans the best, after the fallow next, after turnips by much the worst.

Let the man who would farm in the best manner for profit, never suffer two exhausting crops to follow one another. Let him avoid fallowing; for in my opinion, the more the land is ploughed in summer, the more the vegetable food is exhausted. In the culture of beans, let him give them a fair chance; let him keep them clean, which cannot be done but by hoeing early. Let him manure plentifully, so that he may command large crops, which is of great importance, not only to the crop itself, but also to that which succeeds, for every bushel gained in the crop of beans, is a certain gain in the wheat or barley which follows.

48. *Observations on the above System*.*

THE culture of dry land by means of turnips is well understood; but the management of wet soils is yet in its infancy, except in certain corners of the Island little known, and in the farms of enlightened individuals. I hazard nothing in aſserting, that the great desideratum in British agriculture, is the discovery of fallow crops for clays and wet loams, by means of which summer fallows may be as completely banished from these soils as they are from sands. The practice of Mr. Fiske, which he has concisely, and, as I personally know, candidly described in the above memoir, is a very satisfactory and important step towards the introduction of this system. It is not an experiment practised for a year or two, and then abandoned, but the common management of his farm, in which he relies upon the bean crop for *cleaning* and *improving*, just as much as a common farmer does upon his year's fallow. The beans are more effective, for his wheat crops are upon the whole better than those of his neighbours, though,

* By A. Young, Esq.

by dung and fallow, they almost buy their wheat before they reap it.

Nothing can be clearer, or more decisive, than the comparison, nor can any practice be more secure when pursued with ardour, and with proper attention to the directions given by Mr. Fiske. Manuring is neceſsary to succeſs, unleſs the beans are planted on a lay, which is of all others the best preparation. The hoe should be used inceſsantly, and without sparing expense, as the cheapneſs of this preparation for wheat, when compared with a fallow, will well admit of it. This, a short calculation will sufficiently demonstrate.

FALLOW.

	£.	s.	d.
Four earths	0	17	0
Rent, rates, and tithe	1	0	0
Manure	2	0	0
	3	17	0

BEANS.

	£.	s.	d.
Rent, rates, and tithe	1	0	0
One earth	0	5	0
Seed	0	6	0
Dibbling	0	5	0
Harrowing	0	0	6
Manure	2	0	0
Hoeing	0	12	0
Reaping and harvesting	0	7	0
Threshing nine coombs	0	4	6
Carrying out	0	5	0
	5	5	0
8 coombs of bean, at 12s.	4	16	0
Value of straw	0	9	0
	5	5	0
Expense of bean preparation	0	0	0
Balance difference between beans and fallow	3	17	0

49. *On Tares**.

As the farmers in the north of England are beginning to cultivate tares, it will be proper to remind them, that in consequence of the difference between their climate and that of their southern neighbours, it will be proper if it can be conveniently done, to sow this grain three weeks, or a month earlier. Their season is immediately after wheat harvest.

* By A. Hunter, M. D.

If intended for soiling in the spring, it may be a judicious practice to sow rye with the tares, which will not only increase the quantity upon the land, but be the means of warming and invigorating the tares during the severity of the winter. After the winter tares are consumed, summer tares are usually sown upon the same land by the south country farmers, and these as well as the winter ones are consumed in soiling, a practice much to be commended. Some farmers sow summer tares at different intervals during the summer, by which the practice of soiling may be continued down to the month of October. In place of summer tares, turnips may be sown; or the land may be put under a summer fallow for wheat.

50. *On Winter Tares**.

HAVING reaped a crop of wheat on the 27th of July, I set the sheaves in rows in such a manner as to plough immediately without loss of time. The season being dry it required a strong plough and six horses, the earth breaking up in very large pieces. It was left till

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* By G. H. Sumner, Esq.

rain came, and taking the soil in its right temper, harrowed and worked by two ploughings. The first of September, winter tares were sown, which were begun to be fed by sheep, the 18th of May, and 8½ acres maintained 446 sheep eight weeks: the land was then ploughed for turnips.

Every thing here depended on the first ploughing of the wheat stubble: had that been delayed till the rain would have admitted common tillage, the temper of the land would have been lost. The difficult ploughing in a hard, dry state, prepared the land in the best manner, by leaving it a long time roasting in the sun. How much depends, in many cases, on a single earth given at the right moment!

51. *On Washing Roads* *.

Roads, upon which the traffic is considerable, and the materials for mending them not of the hardest quality, are apt to be extremely dusty in summer, and loaded with mud in winter. The usual method of cleaning them

* By Mr. Ellis.

has been by scraping; but to this mode there is a material objection, that much gravel is carted away, as it is not easy to separate the stones which are ground down from those which are only broken. The expense of thus cleaning is also considerable. Those evils occasioned another practice, that of washing away the mud; this has been found cheaper, more effectual, and takes off only the particles ground too small to be useful. But it can be applied only in certain situations; there must be a declivity to prevent the water stagnating; it should run freely, but not with too great rapidity. Where bracks and streams cannot be turned in, which is often the case, reservoirs by the side of the road answer the purpose, if prepared with attention.

52. *To produce Apples, of which one half of each will be sweet and the other half sour**.

TAKE two scions or grafts, one from a sour,

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* By his excellency John Jay, of New York. This singular experiment is here inserted on the most respectable authority. Its succefs seems to depend on getting the opposite buds to inosculate. The other buds, if permitted to remain, will certainly follow their respective natures. A. H.

the other from a sweet apple-tree; divide or split with a sharp knife each graft into two parts or halfs, taking care to pafs the knife through the centre or middle of as many buds as are in a line with each other; then take one half of the sweet graft and join it to a half of the sour graft, in such a manner that two or more of the half buds on each do exactly meet and fit each other; then carefully wind round them worsted or woollen thread to keep them together; and having thus become one graft, cut it so as that the bark of the wedge part, which enters the stock or tree engrafted, being partly of both kinds, may receive the sap of the stock on both sides. If this artificial graft takes and grows, which frequently happens, the two parts of which it consists will gradually unite and incorporate, and become a tree, whose fruit, *on the branches shooting from the united buds, and partaking of both natures*, will be on one side sweet, and on the other sour. A friend of mine particularly examined an apple of this kind, which on one side exactly resembled a winter apple, called the Rhode Island Greening, but on the opposite side was of a different colour and appearance. He was afsured that this apple was from a tree composed in the manner be-

fore mentioned, of grafts from a Rhode Island Greening, and a common sweet apple. In the first volume of the memoirs of the American Academy, page 386, there is an account of an apple-tree which produced fruit of this singular kind.

53. *On the Threshing Mill* *.

Mefsrs. EDES and NICHOLS, of Elm, in the Isle of Ely, have had a threshing mill, built by Mr. Wigfull, of Lynn, which they have used for four seasons. It was originally made for four horses, but afterwards altered for six. It cost one hundred guineas. Threshes, with ease, 15 to 20 quarters of wheat; 25 to 35 of oats in a day, and would do more. Requires two women, three boys, and two men. It performs its work with every sort of grain, so much to their satisfaction, that they are now building a second at another farm. It was found to exceed the flail so much, that trying the straw of two mens threshing in a day and a half, one bushel of clean wheat was gained.

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* By A. Young, Esq.

54. *The progreſsive Rate of Amelioration of Wool by the Spanish Croſs*.*

THE first croſs of a new breed gives to the lamb half of the ram's blood, or 50 per cent.; the second, 75 ditto; the third, 87 ditto; and the fourth, 93¾ ditto; at which period it is said, that if the ewes have been judiciously selected, the difference of wool between the original stock and the mixed breed is scarcely to be discerned by the most able practitioners. This is an object of the greatest magnitude, when we consider the difference in price between the English and Spanish wool.

55. *On Parsnips†.*

THE Earl of Romney tried an acre of parsnips at the moat; and his succeſs was such, as to give him reason to think the culture highly profitable, He gave them to his cows, and these yielded milk in an uncommon quantity, and better than by any other food he had tried. The cows were as eager for this food as for oil cake.

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* By Dr. Parry.

† By A. Young, Esq.

57. *On Straw Hay* *.

THE second cut of clover, except that cut very early, is often totally lost. Mine, this present year, would have been spit-dung, had it not been carried mere grass, and mixed with some oat straw, saved for the purpose. This plan of management I drew from last year's experience and observation. It is advisable to save a stack of oats until summer, as the second cut of clover is at best precarious. By this management, the straw is converted into hay, and the clover, in case of dripping weather, is saved from the dunghill. The cows eat the little which was mixed last year, as greedily as they did middling hay. Though the clover may be mixed full of sap, it should be perfectly free from water-wet, as that would occasion the hay to become mouldy. By this plan 15s. worth of straw is converted into 50s. worth of hay, besides, perhaps, saving the second cut of clover from the dung-hill.

57. *On Tallow-Chandlers Graves* †.

A FARMER in Surrey used graves from the

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* By Mr. Marshall.

† By A. Young, Esq.

Tallow-Chandlers, with very great succeſs on a sandy soil: ten cwt. per acre, at 3 s. per cwt. have had this year an effect for turnips that is extraordinary. Laid on the poorest part of a field, they have pushed forwards the crop beyond the best soil in it; and rendered it so very superior, that I do not conceive any common dreſsing of the richest dung would have exceeded, nor any common manuring equalled it. The graves were tried on two fields, and the effect was the same in both.

58. *How to collect Materials for Manure* *.

1. STACK all your hay at home. 2. Chop your stubbles. 3. Cut up all the fern, rushes, nettles, thistles, and weeds, that grow in the lanes, and cast them green into the fold yard. 4. Rake up all the leaves that fall from the trees, and carry them home for littering the stables and cow-houses. 5. Enrich your compost dung-hills with the blood and offal of the slaughter-house, together with the cut-up carcaſses of animals that die upon the farm. 6. Let no excrementitious matters go to waste.

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* By A. Hunter, M. D.

7. If an arable farm, be careful of the dung of the pigeon-house, and poultry-yard, and preserve it for the top-dreſsing of your wheat in the spring. On top-dreſsings much depends. Men who are capable of making such provision for their lands, will be sure to find a grateful return on the part of the soil; and until they can bring themselves to a just feeling of the propriety of these directions, they must not bestow upon themselves the honourable appellation of "Husbandmen," for in fact they are no better than "Labourers."

59. *On laying land down to graſs* *.

For laying down land to either meadow or pasture, the common practice is to sow hay-seeds, which are the sweepings of hay-lofts, procured at from 10d. to 1s. 3d. per bushel. These are sown in the quantity of about ten or twelve bushels per acre, and ten or twelve pounds of white clover, under barley, or on land that has been made perfectly clean by a summer fallow.

By this mode it frequently happens that very bad sorts of graſses are raised, and

* By Mr. John Boys.

instead of good grafses free from weeds, every kind of rubbish is introduced that no future care can eradicate. It is, therefore, a more judicious method, and indeed the only good one, until the best sorts of grafses are more generally cultivated for sale, to save for seed a piece of fine old meadow that is known to abound in the best sorts of grafs, by letting it stand about three or four weeks longer than it should, when intended to be mown for hay. When it is mown and ripe, let it be thrashed on a sail-cloth in the field, and immediately sown upon a piece of land intended for the new pasture; which should, by a good summer fallow, be brought into fine tilth to receive the seed. This, with ten or twelve pounds of white clover, will make an excellent meadow. The culture, with the turn-wrest plough, leaves the land so perfectly clean that no other instructions are neceſsary beyond harrowing the seed in and frequently rolling the land until the grafs be well matted, and the land becomes firm enough to bear the tread of cattle.

60. *To destroy Thistles**.

The best way to destroy thistles in high-

* By Mr. Boys.

ways, and on grafs lands, is to let them alone till they are in full bloom, and then to mow them with a scythe; for if they are cut when young, they produce fresh shoots from the sides of each plant; but when mown in full bloom, the stem is hollow, by which the rain water and dews descend into the heart of the plant, and it soon dies.

61. *On steeping Seed Wheat*.*

In order to prevent wheat from being smutty or slain, brine, made of sufficient strength to swim an egg, or instead of that, stale urine, has been generally used; in these the seed is put, and after being well stirred about, and the light grains that float to the surface have been skimmed off, it is taken out, and mixed with a little fresh slaked lime; this forms a coat on the surface of the grain, and by imbibing the moisture, makes it immediately fit for sowing. Nevertheleſs, a considerable inconvenience attends steeps in precarious seasons of sowing; for if the weather should be such, as to prevent the seed thus steeped from being sown within

* By Mr. John Tuke.

two or three days after it has been prepared, the vegetation of the seed will be injured. A farmer in Devonshire made a valuable discovery a few years ago, of the means by which this disease is propagated, and of the cure for it, which he proved by experiment on my farm, as well as at several other places, to my full satisfaction. As the remedy is perfectly simple, it is the more desirable that the practice should be known and adopted, nothing more being required than that the wheat should be thoroughly washed, and in several waters, if it appear neceſsary. He proved the effect of it in the following manner: he took a small quantity of wheat of my own growth, not entirely free from the disease, then mixing some powder of the smut with two-thirds of it, he divided these again into two parts, one of which he washed clean, after which the three samples were sown in three rows in my garden. The result was, that the row of washed corn was perfectly free from smut; the row of smutted corn, not washed, was generally smutty; and that which was sown in its original state, had a few smutted ears in it. I have continued this practice ever since, and have not known it fail. Whatever may be the original cause of the disease, the

above experiment proves, that it is continued by some portion of the smutty plant adhering to the seed.

62. *On the construction of habitations for Labourers* *.

The seven following principles may be considered as the means of obviating any inconveniences to which cottages, as usually built, are liable.

1st, The cottage should be *dry* and *healthy*; this is effected by keeping the floor sixteen or eighteen inches above the natural ground †: by building it clear of banks, on an open spot of ground, that has a declivity or fall from the building, by having the rooms not less than eight feet high; an height that will keep them airy and healthy; and by avoiding having chambers in the roof.

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* By Mr. J. Wood.

† For want of this precaution, I have always observed, that in wet summers, and throughout the whole winter, the walls sucked up (if I may be allowed the expression) the water, and are damp for at least a yard high; and this happens not only where the walls are thin, but even in buildings where they are thick.

2dly, *Warm, cheerful, and comfortable.* In order to attain these points the wall should be of a sufficient thickneſs (if of stone, not leſs than sixteen inches; if of brick, at least a brick and a half) to keep out the cold of the winter, or the exceſsive heat of the summer. The entrance should be skreened * that the room, on opening the door, might not be exposed to the open air; the rooms should receive their light from the east or the south †, or from any point betwixt the east and the south; for if they receive their light from the north, they will be cold and cheerleſs; if from the west, they will be so heated by the summer's afternoon sun, as to become comfortleſs to the poor labourer after an hard day's work; whereas, on the contrary, receiving the light from the east or the south, they will be always warm and cheerful; so like the feelings of men in a higher sphere, are those of the poor cottager, that if his habitation be warm, cheerful and comfortable,

* This circumstance must be particularly attended to, in those rooms where there is intended to be a bed.

† At first view this nicety may appear trifling, but on mature deliberation will prove of very material consequence.

he will return to it with gladneſs, and abide in it with pleasure.

3dly, *Convenient*; by having a porch or shed, to skreen the entrance, and to hold the labourer's tools; by having a shed to serve as a pantry, and store-place for fuel; by having a privy * for cleanlineſs and decency's sake; by a proper disposition of the windows, doors,

* This convenience will answer many good ends, but in nothing more than being an introduction to cleanlineſs. In the account of the Voyage to the South Sea, published by Dr. Hawkesworth, speaking of the inhabitants of New Zealand, is the following; "In personal delicacy, "they were not equal to our friends at Otaheite, for the "coldneſs of the climate did not so often invite them to "bathe, but we saw in them one instance of cleanlineſs, "in which they excelled them, and of which, perhaps, "there is no instance in any other Indian nation; every "house, or every cluster of three or four houses, was "furnished with a privy, so that the ground was every "where clean." What a reflection is this on the greatest part of the inhabitants of Britain, to be exceeded in neatneſs in any one point, by that barbarous race of people the New Zealanders? I could mention many large and opulent towns, particularly on the sea coasts, nay some large cities, where there are but few such conveniences, for want of which the streets are perfect jakes; to the annoyance of both inhabitants and strangers.

and chimneys; by having the stairs, where there is an upper floor, not leſs than *three feet* wide; the rise, or height, not more than *eight inches*, and the tread, or breadth, not leſs than *nine inches*; and, lastly, by proportioning the size of the cottage, to the family that is to inhabit it; there should be one lodging-room for the parents, another for the female, and a third for the male children; it is melancholy to see a man and his wife, and sometimes half a dozen children, crowded together in the same room, nay often in the same bed; the horror is still heightened, and the inconveniency increased, at the time the woman is in child-bed, or in case of illneſs, or of death; indeed whilst the children are young, under nine years of age, there is not that offence to decency, if they sleep in the same room with their parents, or if the boys and girls sleep together, but after that age they should be kept apart*.

* I am aware that the statute of the 5 Eliz. concerning the apprenticing poor children, and compelling adults to go out to service, will be here objected to me; but the objection soon vanishes when we consider, first, that it may be policy, in many cases, to let the children live at home with their parents till they are grown up, parti-

4thly, Cottages should not be more than *twelve* feet wide in the clear*, being the greatest width that it would be prudent to venture the rafters of the roof with the collar-pieces *only* †, without danger of spreading the walls; and by using collar-pieces, there can be fifteen inches in height of the roof thrown

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cularly in the manufacturing countries; where the trade of the father will be more carefully taught the children, whose earnings often, nay generally, contribute to the better maintenance of the family. Secondly, the power given to the parish officers by that act, is very much circumscribed, and is confined merely to their own parishes; indeed they may, if they can find proper masters in other parishes, bind out their orphan poor, and the children of such poor as are willing to part with them; but this must be done by consent of the magistrates, who should be very careful how they take the burden off one parish, and lay it on another.

* Twelve feet is a width sufficient for a dwelling, that is to be deemed a cottage; if it be wider, it approaches too near to what I could call a house for a superior tradesman; besides, it would require longer and stronger timbers, girders to the floors and roof, and consequently greatly enhance the expense; a circumstance one would wish in all buildings to avoid.

† A collar piece, is that piece of wood which ties the rafters together at some height above the wall plate, and is generally tailed into the rafters.

into the upper chambers, which will render dormer windows useleſs*.

5thly, Cottages should be always built in *pairs*, either at a little distance from one another, or close adjoining, so as to appear one building, that the inhabitants may be of aſsistance to each other, in caſe of sickneſs or any other accident.

6thly, As a piece of economy, cottages should be built strong, and with the best of materials, and these materials well put together; the mortar must be well tempered and mixed, and lime not spared; hollow walls bring on decay and harbour vermin; and bad, sappy timber soon reduces the cottage to a ruinous state; although I would by no means have the cottages fine, yet I recommend regularity, which is beauty; regularity will render them ornaments to the country, instead of their being at present disagreeable objects.

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* Because the room being six feet and ten inches high to the top of the wall plate, there will be sufficient height to make a window in the side wall, under the plate.

7thly, A piece of ground should be allotted to every cottage *, proportionable to its size; the cottage should be built in the vicinity of a spring of water, a circumstance to be much attended to; and if there be no spring, let there be a well.

On the foregoing seven principles, I recommend all cottages to be built †; they may be divided into four clafses or degrees: first, cottages with one room; secondly, cottages with two rooms; thirdly, cottages with three

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* This will hold good in the country, where ground is not of so great a value, but in towns we must be content with a small outlet behind.

† I cannot more properly than in this place observe, that near Dorchester, in Dorsetshire, there has been lately erected a row of cottages for the accommodation of adjoining farms, in which there has not been the least attention paid, either to the principles of sound building, or to decency or conveniency. The entrances are from the west, and not skreened; the windows are to the same point; the cottage is 17½ feet wide in the clear, and the whole triangular space of the roof occupied as a chamber. The consequence is, that the walls, which have not been built more than three years, are already considerably spread, and must in a short time fall down; the poor inhabitants told me that they could scarcely

rooms; and fourthly, cottages with four rooms. In the first volume of Agricultural Communications, there are plans of each of those kinds of cottages.

63. *On the application of Manure to Sandy Soils**.

MANURES put upon sand-land when under tillage, should not be ploughed in, but laid on the top, and harrowed in with the seed; for if the manure be a compost of a different nature, its specific gravity is generally more, and it soon sinks sufficiently deep; and by being mixed with the seed, it gives vigour to the vegetation of it, and supports it through

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support the heat of these rooms in the summer, and that they were quite frozen in the winter. The indecency of one chamber for a large family is here very striking; and what adds to the shamelefsnefs of it, was the partitions between house and house being nothing more than thin rough boards, not jointed; and yet the rent paid for each cottage is 52s. a year. It is a pity that gentlemen, who build cottages for the accommodation of their labourers, did not study stability for their own sakes, and conveniency and decency for the sake of the inhabitants; for, believe me, the poor man wishes for conveniency, but knows not how to remedy himself, and would be decent, was it in his power.

* By Mr. Greenall.

its growth, by following the fibres of the roots as they strike into the land. I need not remark, that, previous to laying down any kind of land to grafs, it is neceſsary to make it perfectly clean; when it is so, it should have a good dreſsing of manure harrowed in along with the seed.

64. *On Paring and Burning* *.

When land is pared and burned, I hold it a good and profitable practice to give it a dreſsing of compost earth, and to spread the ashes and it together while they are yet warm, and immediately to plough them under. The ashes impregnate the compost with their saline virtues, and the compost replaces the soil destroyed by the fire.

65. *On the Culture of Turnips* †.

On comparing the drill with the broadcast system of cultivating turnips, I feel no hesitation in giving the drill system the preference; which opinion is gaining fast amongst my neighbours, who have had an opportunity of comparing the two methods. To say nothing

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* By Mr. Greenall.

† By Dr. Campbell.

of the superior, neat, and workman-like appearance which a field of drilled turnips exhibits in all its stages, there are many circumstances which contribute to give it a superiority over the broadcast.

The first is, the greater security of the crop from the ravages of the fly. When dung is spread at random over a field, a part will receive a greater proportion of it than is necessary, and another a smaller. Should dry and hot weather come on immediately after the sowing, the dung that is exposed to the influence of the sun will be dried up, and a great part of its juices, and the volatile alkali which it contains, will be exhaled and lost. The seeds that fall in the intervals betwixt the dung, or where there is a deficiency of it, will languish, or perhaps be cut off by the fly or snail, and at any time will never attain a full size. In the case of the drill method, the dung being buried in the bottom of the furrows, is excluded from all evaporation, and the seed, being deposited directly above the dung, is, by the warmth which proceeds from it, brought into immediate vegetation; and the young roots, as soon as the seed germinates, striking into the dung, occasion so rapid

a growth, that in a few days the plants pafs into the rough leaf, and get beyond the risk of injury from the fly, slug, or whatever vermin have a tendency to prey upon them in their weak state. It would appear that the weak and sickly plants are particularly the objects of these destroyers, rather than the luxuriant and healthy. Vegetables in a certain state of decay, and of a yellow hue, are most sought after and preyed upon by slugs in a garden; and I have taken notice that some turnips, from seeds accidentally dropped in the intervals of the drills where there was no manure, have exhibited a sickly hue, and have been preyed upon by some insects, whilst the vigorous plants in the drills escaped. In the course of the last three years that I have cultivated turnips, in seasons where we have experienced the extremes of wet and drought on their coming out of the ground, I have not lost a single plant by the fly; which I am inclined to attribute to the rapid growth of the plants from the causes above enumerated.

Another advantage arises from the being able to stir and horse-hoe the land in the intervals of the drills; by which means the

weeds are more early and completely destroyed, at the same time that the ground is more effectually opened.

60. *On the Course of Crops*.*

Upon my farm, which is of a sandy nature and without stones, the course is, first year, swarth ploughed up for oats; second, buck-wheat; third, turnips; fourth, oats, with grafs seeds, viz. white clover, trefoil and ray-grafs. To remain three or four years. My reason for introducing a crop of buck-wheat after the first crop of oats, is, the excellent order in which the land turns up when worked for the succeeding crop of turnips; and those two crops coming in succeſsion, both of which may be considered as fallow, the land is in fine order for laying down to grafs with a crop of corn. When a field is intended for buck-wheat, it must be made very fine by repeated stirrings. About the first week in June is the best time for sowing it, but when cultivated in a large scale, we may begin a little earlier. Being a tender plant, severe frosts will entirely destroy it, so that we ought to be very cautious not to sow too early.

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* By Lieut. Col. Vavasour.

When in seed leaf, I have known a whole field destroyed in the month of May. My soil being light and free from stones, I have found great benefit from the use of the cultivator. After the land has been once ploughed and harrowed, this instrument may be introduced to pulverize the ground, and to destroy the weeds. Six or seven acres may be worked in a day, with ease, by one man who drives three horses a-breast. In such soils as mine, I believe two horses in six may be saved by the use of this excellent implement.

67. *On Buck-wheat Hay**.

The buck-wheat is mown when in full flower, and after being suffered to lie a few days in swarth to dry, it is turned over. After lying a few days longer, it is carried to the stack in a much greener state than is commonly ventured upon with clover. The bottom of the stack should be laid with faggots, to admit the air, and upon them some straw should be put; then a layer of buck-wheat, about a foot in thickneſs; upon this, a layer

* By Lieut. Col. Vavasour.

of straw about four inches in thickneſs, and so on, buck-wheat and straw in alternate layers until the stack is completed. In consequence of the dryneſs of the straw, the moisture of the buck-wheat is absorbed, and the danger of heating prevented. I consider the straw as much improved by the proceſs, in consequence of its having imbibed the sap of the buck-wheat, which must render it more nutritious. After buck-wheat mown for hay, a clear crop of wheat may generally be gained, as the land will be in fine tilth. The straw of buck-wheat, grown for seed, I find to be as good for cattle in the fold-yard as any other straw. Pigs do well on buck-wheat mown green, but it frequently has an intoxicating quality, more particularly when given to young pigs.

68. *On laying Barn Floors**.

About twenty years ago I laid a barn floor with oak beams, fourteen inches square, and three inch oak plank; the plank was fourteen inches hollow from the ground, and the beams about two feet asunder; in two years after,

* By Mr. Chambers.

some part of the plank broke down, without any other use than common thrashing upon; I examined the reason, and found the underside of the plank decayed by the damp rot, nearly through; upon which I had the floor taken up, and found all the planks in the same situation, and the beams almost totally perished; upon which I consulted a very experienced architect, who advised me to lay the next floor still higher than the former, and if poſsible to admit a circulation of air under the same, as the situation of the barn must be very subject to the damp rot. I relaid the floor with new beams and plank of the same thickneſs as the former; the beams were fixed upon brick pillars, fourteen inches high, so that the floor lay twenty-eight inches hollow; and under each door-sill was two grates, about one foot square each, that gave a current of air under the floor through the barn, and by the beams being laid upon supporters of brick, the whole floor was hollow except the nine inch pillars.

The current of air was not through the middle of the floor, as the doors were more to one side than the other. In about two years the planks that were farthest from the

paſsage of air fell down, all reduced to rotten wood, but about three-eighths of an inch at the upper-side; upon taking up the floor, I found the beams nearly reduced to rotten wood, except those that lay near the current of air, which were very sound, as was also the plank that lay over them in that situation.

After these trials in the usual way of laying barn floors, I determined upon the following experiment:—to lay the next floor solid, in lime and sand mortar; upon which I removed every part of the former materials, and fixed fresh beams upon a spreading of mortar, at about six feet asunder, so as to suit the piecing of the planks to pin to; between each beam I filled the space with stones and thin mortar, that the whole was made solid with the upper sides of the beams; when this preparation was sufficiently dry, I culled the best of the remaining planks from each of the former floors, and before the workmen laid down each plank, the space that I covered was spread with fine mortar, even upon the beams; then the plank was laid down and pinned; so that every hollow part, either in the beams, or decayed parts in the planks, was filled solid with

the mortar. The floor has now laid about sixteen years without any amendment, except one of the planks being so weak in sound wood, that it started from the pins a year ago; after taking the same up and examining the under-side, I found such of the plank that was sound when last laid down, was still perfectly so, and the rotten part was firmer and stronger than when laid down.

I have mentioned the above circumstance to several workmen, but few will follow the practice without peremptory orders, which I have followed up, with twenty different floors in sixteen years; some of oak, and some of deal planks, in different situations, and all appear as if they would stand for ages, unleſs they wear through from the upper side.

About ten years ago I ordered a floor to be laid with ash plank, (in the method above) as oak could not be got without cutting down oak trees to considerable loſs; the ash was fallen, sawed up, and laid down in the floor immediately, as the saw had left it; the joints did not open much before the last summer, upon which I had the floor taken up and relaid, as the plank must be well seasoned in

nine years use; the under-side of which was as sound as when first put down.

There are other advantages by laying barn floors solid with lime mortar, as a barrier againt rats and mice, worms, &c. prevents the joints from wear, by quivering, &c. and also prevents any loſs in the corn through the joints.

I am pretty confident that the same method will hold good in laying ground floors with boards, in gentlemens' houses, that I have frequently seen them rot and eat through with worms in a few years. Both of these maladies the lime mortar will prevent, and will make the floor warmer also.

It will hold good to cover the lath and pin, or nail, in the under-side of slate and tiled roofs, by starting or rough-drawing the same, so as to cover the lath, &c. close. My first observation of this simple method was about twenty years ago, being witneſs to the pulling down of an old timbered house, dated 1564; between each beam were pieces of ash wood, with split ash and hazel laths, and plastered on each side with lime or plaster mortar;

where the plaster was free from cracks, the laths and the bark of them was as sound and fresh as if they had not been cut down three months, but where the cracks had admitted the air, every part of the lath, &c. was reduced to nothing. I have lost no opportunity since my first observation, to examine all old ruins, and where I have found any old timber within those walls that had been run with thin mortar, the same has been sound and fresh, though the building has been in ruins for two centuries.

69. *On Hedge-row Planting* *.

THERE is a general prejudice against planting trees in hedges, as being supposed to injure the land. Whatever may be the case with regard to corn, which I apprehend to be much exaggerated, it does not appear to be injurious to grafs; and there cannot be, in my opinion, a better or more convenient method, for many purposes, than always to leave a head-land in grafs, as may be seen in many parts of Hertfordshire, under the name of hedge-greens. It is obvious that a great

* By Robert Lowe, Esq.

quantity of timber may be raised in hedge-rows, which is better for various purposes, than what is raised in woods, particularly compaſs timber, as knees, crooks, &c. the most valuable pieces in ship-building.

I believe I may venture to affirm, that trees so planted are likely in twenty-five to forty years, to equal the value of the land, whilst in their growth they have taken up no land from other purposes. I recommend seedling oaks, or acorns, to be put down at a foot or two from the quickwood in all new inclosures; and next to oaks, elms, but that species which does not shoot out suckers.

70. *A Speculation*.*

It is my intention, in March or April next, to sow upon an acre of land in the centre of a large graſs field, about fourteen pounds of white clover seed. The close was well manured from the fold-yard in November last, and has never yet been harrowed. After sowing, and harrowing with a common harrow, to scratch the swarth a little, I mean to

* By William Calvert, Esq.

make it fine by means of a thorn harrow, and wait the result of my experiment, which is intended to show how far grafs land may be improved without ploughing.

71. *On large and small Inclosures* *.

Small inclosures of grafs land answer much better than the same quantity in large ones (except in pastures for sheep, which are required to be large for the benefit of cool breezes in summer). I constantly see small closes, surrounded with good white-thorn hedges, bear a greater burden of herbage in proportion, than large ones; and the reason seems evident. Independent of the manure deposited in the shade by cattle when sheltering, in spring, when the cold sharp winds blow off from the surface of the ground the warm atmospheric air occasioned by the reflected rays of the sun, in the same manner they blow off the circumambient warmth, caused by perspiration, from our bodies, and render us more sensible of cold than in still calm weather, though the thermometer points the same degree. The wind, by having to pafs the interwoven branches of the thorn-

* By William Calvert, Esq.

hedge of a small inclosure, is not able to resume its former violent current before it becomes again broken and divided by another fence of the same kind. In summer, when much hot and dry weather prevails, the hedges shade off the sun and wind, so as to prevent the moisture left by showers and dews from exhalation; of consequence, vegetation is more encouraged than where the ground is more parched.

72. *On the Ruta Baga*.*

Mr. Daikin, on the tenth of May, 1794. sowed about four acres with the seed of Ruta Baga, two pounds per acre, on good sand land, worth twenty shillings an acre, manured as for turnips, and having been ploughed four or five times; the rest of the field, to the amount of nine acres in all, with common turnip, and turnip-rooted cabbage, all broadcast. The Ruta Baga was not transplanted, but hoed out nine inches asunder, at three hoeings, at seven shillings and sixpence an acre: no other culture. In November he began to use them for horses, giving at first clover and rye-grafs, hay, oats, and beans;

* By Robert Lowe, Esq.

but finding that the horses did well upon them, left off all corn, and continued them, on hay, and the roots only; fifteen were thus fed for about two months, were constantly hard worked, and preserved themselves in very good condition. Mr. Daikin is so well convinced that in this application they were worth thirty pounds an acre, that he would in future, if he could not get them otherwise, rather give that sum per acre for one or two acres, than not have them for this use. They lost their leaves entirely when the frost set in; but the roots were not in the least affected, though the common turnips in the same field were totally destroyed. Paſsengers paſsing through the field cut holes in them, which did not let the frost injure them, nor were those hurt which were damaged by cattle biting them. Some came to the weight of 16 pounds, and Mr. Daikin thinks the average of the crop 8 pounds, and much to exceed in tonnage per acre common turnips. Mr. Daikin gave them also to hogs, cattle and sheep. They are excellent for hogs; and sheep being let into the field before the common turnips were destroyed, gave so decided a preference to the Ruta Baga, that they would not settle on the common turnips,

while the others were to be had. The method of giving them to horses, is to cut off the tap-root, to wash them, and to cut them roughly with a perpendicular hoe, and then giving them directly, without keeping them to dry. The horses ate them with avidity, and seemed to prefer them to corn. Their qualities seem to be singular, as they bind horses instead of relaxing them, as other roots do. One mare was kept entirely upon them and straw, worked every day, did well, and never looked better; this mare was more bound by them than the rest. They have a strong effect upon making the coats fine; and one or two horses affected by the grease, were cured by them, as they act as a strong diuretic. In this mode of application, one acre maintained fifteen horses about two months; and Mr. Daikin is so well convinced of the utility of the plant, as well as many of his neighbours, that he intends, and they also, to increase the cultivation much. Mr. Daikin suspects that there are two sorts of Ruta Baga, because some upon cutting are white within, but in general yellow; otherwise of the same external appearance. The yellow is the best. This valuable plant should be sown about a month before other turnips.

73. *On Skegs* *.

There is a species of oat (*avena nuda*, Linn.) the cultivation of which seems to be confined to the counties of Nottingham and Cornwall. Eight strikes are sown. They yield a crop nearly double in measure to other oats sown upon the same land, but not more than equal in weight. They will grow upon the poorest land, where no other grain will grow. They are seldom brought to market, but generally kept by farmers for their own use, and are esteemed a sweet food for horses, being often given to them in the straw. Upon poor weak lands, when the hay-seeds are quite worn out, and the farmer cannot afford a sufficiency of manure for turnips, it may be convenient for him to know, that upon such land he may profitably obtain a crop of skegs.

74. *On the Improvement of Vegetables* †.

As in the animal world "*fortes creantur fortibus*," so may not something of the same kind be observed among vegetables? If this analogy may be depended on, I should re-

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* By A. Hunter, M. D.

† By A. Hunter, M. D.

commend the finest and boldest ears of all kinds of grain, and pods of pulse, to be gathered by the hand, and to be made a stock for future plants. I am inclined to think that such an attempt in the hand of a careful and judicious cultivator, would be productive of much good. The potatoe oat, so remarkable for its weight, probably had its origin from a selection of this kind.

75. *On the Purification of Gray Marine Salt, without Expense*.*

GRAY, or unrefined marine salt, is covered with a thin earthy crust, which alters more or leſs its whiteneſs; and it is of some conſequence, both in regard to cleanlineſs and health, to purify it from this heterogeneous ſubſtance which covers all the faces of its cryſtals.

Hitherto this ſalt has been purified only by ſolution, filtration, or precipitation, according as the operation is performed on a large or a ſmall ſcale, and then by evaporation. This method requires time, wood or charcoal, and proper veſſels. I have thought that a proceſs

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* By Mons. Pagot Descharmes.

that requires neither fire nor particular veſsels, is attended with no expense, may be practised at all times, and is within the reach of every one, might be of general utility. My method is as follows:

Take four ounces of gray salt, and, if dry, besprinkle it gently with water till it be only what is called moist; but it will be very seldom neceſsary to have recourse to this operation. Put the salt into the corner of a table napkin, or piece of linen cloth, and form the cloth into a knot or bag, which you must hold in one hand, while with the other you rub and shake the salt against the inside of the cloth for the space of half an hour. Then shift the salt to another place of the cloth, succeſsively repeating the same manœuvre six, seven, or eight times, according as the salt is more or leſs gray. After the salt has been rolled for the first time, the cloth begins to exhibit spots occasioned by the earth which the salt deposits, and of which the intensity sensibly decreases at each change of place till they entirely disappear. In general the salt must besprinkled every time that its place is changed. The bleaching will be accelerated by pounding the salt slightly before it is besprinkled.

After two or three aspersions and rubbings, the salt is, in general, as pure and white as that refined, according to the usual method, by solution and evaporation. The loſs in both cases is nearly the same; that is to say, about an eighth, when the salt is dry, and when care has been taken at each change of place to shake off the grains which adhere to the cloth. It is, for the most part, the whitest salt which adheres in this manner; and it may be shaken off without fear, as the earth deposited on the cloth cannot detach itself till the cloth is dry. The gray salt of commerce contains in general $12\frac{1}{2}$ per cent. of foreign matters, nearly one half of which is water, and about as much earth. This proceſs, on account of its simplicity, I consider as likely to become useful for domestic purposes.

76. *On Hand-Weeding Wheat**.

In the month of April I hand-weeded a a crop of wheat, which was to all appearance smothered by weeds, particularly by hariff, or herriff, so as that very little wheat was to be seen. I ordered it to be harrowed, which was done till I perceived that the harrows

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* By Mr. Calvert.

drew up more corn than I wished, still leaving many weeds. The soil a light silted land. I then desisted, and employed a number of women to creep over the field, with directions to pluck up every weed, however small; they obeyed my directions pretty well, at the expense of five shillings per acre; and, notwithstanding there scarcely appeared any wheat after the operation, in about three weeks the crop looked well, and became sufficiently productive, yielding nearly four quarters per acre. The wheat weighed sixty-five pounds per Winchester bushel.

77. *On forming Roads on Clay, or Wet Bottoms*.*

First throw the soil from the sides, leaving a groove in the middle for the materials, beginning with kid or brush-wood plentifully, then stones and gravel: if the gravel be very sharp and good, there is no occasion to round the road. Even a concave surface is found to answer very well; but where the materials are tender, it may be better to round it a little, but not so much as is frequently done,

* By Robert Lowe, Esq.

being often dangerous, and hurtful to the road by obliging the carriages to keep one tract.

78. *On procuring Opium from Lettuce.*

THE plant which has hitherto been cultivated for the production of opium is the *Papaver Somniferum*, Linn. or white poppy. It is an annual plant, from the heads of which opium is obtained in Persia, Arabia, and other warm regions of Asia, by making in them longitudinal incisions, from which a milky juice exudes, and which being inspissated, forms the officinal opium.

It has been long known that lettuce possesses narcotic properties; till lately, however, none have extracted from it a substance possessing all the properties of opium. The milky juice from which the opium is prepared exists in the stalk and the leaves of the plant. The best time for collecting the milky juice is when the plant is beginning to seed. Before this it has not acquired its medicinal properties. It is procured in the same manner as from the poppy, viz. by incision, with this difference, that in the poppy the incisions are longitudinal, but in the lettuce they must be circular. The juice exudes in milky drops,

which inspiſsate, when it may be scraped off and deposited in proper veſsels. Attempts have been made to obtain opium from the poppy, by pressure, but the other juices of the plant seem to alter it entirely. Dr. Cox, of Philadelphia, found the lettuce opium to answer, in the public hospital, all the purposes of the eastern.

79. *On the covered Fold*.*

I RECOMMEND to gentlemen who are in poſseſsion of parks, plantations, and lands, in their own hands, to cause a permanent fold, during the winter months, to be pitched in some sheltered spot, near their woods, and to pen their store stock in it, giving the sheep the quantity of hay they are accustomed to have, in racks in the fold, and littering it every night with fresh leaves of trees, rushes, moſs, fern, or any other similar rubbish that can be collected. This turned up together in the month of April, and mixed with about one-sixth part of lime, rubbish from old walls, or any sort of ashes, will make as good a sort of manure as can be laid on for turnips. The quantity will be very considerable. On one

* By N. Kent, Esq.

of his Majesty's farms at Windsor, I made, in one winter, six hundred cart loads from six hundred sheep. Every gentleman, however, who tries this, must set out with a determination not to be defeated by the prejudice or obstinacy of their bailiffs and shepherds, who will endeavour to persuade them out of it, by suggesting that it will not answer the expense, and that it will injure the sheep, which last will be an asfertion without the least foundation of truth.

80. *On the Supports of Agriculture**.

In agriculture there are three persons who have a natural dependence on each other: the gentleman of landed property, the farmer, and the labourer. Their degrees of interest are different, but their connection must be permanent, as they cannot subsist without the aid of each other. Protection is due from the first; humanity from the second; and obedience from the third. Sound policy dictates a due observance of this mutual obligation, and the preservation of a proportionate and just scale in respect to every thing

* By N. Kent, Esq.

which mutually affects the parties: a departure from this, will, in the first instance, prove detrimental to one of them, and cannot ultimately be of any advantage to the others.

Admitting this, as every impartial man must, and comparing the advanced price of provisions, with the present rate of wages, and the price of labour, the cause of the increase of the poor rates must be obvious. I would therefore advise every gentleman in the commiſsion of the peace, carefully to peruse Fleetwood's *Chronicon Preciosum*, which will show him the proportions which were observed at that time; and likewise to advert to two particular acts of parliament, framed by the wisdom of our ancestors, viz. the fifth of Elizabeth, chap. iv. and the first of James, chap. vi.; where sufficient power is given to regulate this important buſineſs.

I would advise every farmer to consider the labourer not as an incumbrance upon him, but as a man eſsentially neceſsary to carry on his buſineſs, without whom he could not live, or support his own family; but the present weak policy has arisen from a misconception of the utility and real importance of the labourer to

society. No farmer will slight his horse, or give him the leſs corn for its being dear; if he did, he would expect the animal to decline in condition. Why then should the human servant be leſs attended to? He is, undoubtedly, the first sinew that puts the labour of the farm in motion, and without which it cannot be carried on: If, therefore, his full earnings will not keep him, it is a duty incumbent on his master to let him have a sufficiency of corn for his family, at the same rate by which he is paid for his labour, and not to suffer the spirit of a poor man of this description to be broken.

31. *On converting Weeds and other Vegetable Matter into Manure*.*

The method of doing this is as simple as, I trust, it will be found useful. It is nothing more than green vegetable matter, decomposed by quick, or fresh burnt lime. A layer of the vegetable matter about a foot thick, then a very thin layer of lime, beat small, and so on; first vegetable, then lime, alternately. After it has been put together a

* By Mr. Browne.

few hours, the decomposition will begin to take place; and unleſs prevented, either by a few sods, or a few forkfuls of vegetables at hand, it will break out into a blaze, which must at all events be prevented. In about twenty-four hours the proceſs will be completed, when you will have a quantity of ashes ready to lay upon your land at any time you could wish. Any, and all sorts of vegetables, if used green, will answer the purpose; say weeds of every description. They will doubly serve the farmer, as they will not only be got at a small expense, but will in time render his farm more valuable, by its being deprived of all noisome weeds.

Should this composition answer the purpose, as I flatter myself it will, a very short time will see almost every weed destroyed; which supposing to be the case, I have made my calculations with clover, grown for the purpose; for instance, I will take one acre of clover, which at one cutting will produce from fourteen to eighteen tons of green vegetable matter, and about three tons of lime; this, when decomposed by the above proceſs, will yield ashes sufficient to manure four acres; the value of which I estimate at something under

four pounds; the clover, according to the value of land here, I will say two pounds, which, if we take the average of the kingdom, is too much. The lime I will also say two pounds; but that will vary, according to the distance of carriage. Take them together, this will be about the average value. Now if this is the case, and as far as I have been able to try I find it so, how valuable must it be to the community in general!

The vegetables should be used as soon after they are cut as poſsible, and lime as fresh from the kiln as the distance will allow of; as on these two circumstances depends the goodneſs of the composition.

82. *On Lime**.

Though contrary to the experience of the well-informed and chemical agriculturist, lime is, by the generality of farmers, considered as an enricher of the soil; and used accordingly upon all lands, without discrimination. Fallow after fallow is limed, yet no observations are made, no facts attended to. I have been in the habit of using lime upon my own

* By Charles Howard, Esq.

farm, and at first, as my neighbours did, without the least knowledge of its properties; sometimes with succeſs, but very often without deriving any benefit from it; and even in some cases I have been led to think that it proved injurious.

Regretting my ignorance of its mysterious powers to a profeſsional gentleman in this neighbourhood, and requesting information as to its nature, he made me the following very expreſsive answer: "Lime acts as a stimulus, not as an enricher of the soil. Use lime therefore to your land, as you would spurs to your horse; if he is in condition and can go, make him; but do not urge him beyond his strength." To this invaluable maxim I have since adhered, and in no one instance have I failed of succeſs. I have used lime as recommended by Mr. Tuke, in his excellent Survey of the North Riding of Yorkshire, in very large quantities, even as much as eight chaldrons of thirty-two bushels per acre; but this should be rarely repeated. On my spring fallows, I spread the lime as soon as it is sufficiently fallen, previous to the two last ploughings, and harrow it in immediately; by this means the lime becomes intimately

mixed with the soil; and a high degree of amelioration succeeds. My practice has been, to sow land thus limed, with rape and grafs seeds, for which it is in a proper state; and from the observations made upon my farm, it appears to be particularly eligible for this crop; the pasturing of which, with sheep, exhibits the effects of lime to great advantage, by giving it additional matter to act upon. The seeds are luxuriant, a large quantity of stock is consequently kept, and the whole train of agriculture thereby improved.

I have dreſsed graſs leas of three years, with great succeſs, in the manner recommended by Mr. Henry, in the Second Volume of the Georgical Eſsays, page 58, and have also used lime in composts with dung; but have not found it to answer so well when spread alone. The lime I use is from Knottingley, and I lay it on generally at the rate of six chaldrons per acre. My soil is a sandy loam for the most part, incumbent upon a retentive sub-soil of a marly quality. I consider this manure as invaluable, if applied with judgment, in large quantities, and not too often repeated: it plainly appearing that greater benefit is derived from this mode of using it,

than when laid on frequently in small quantities. But let it ever be held in remembrance, that "Lime acts as a stimulus, not as an enricher of the soil. Use lime therefore to your land, as you would spurs to your horse; when he is in condition and can go, make him; but do not urge him beyond his strength."

83. *On the Application of Turnips* *.

I HAVE usually given my turnips to different stock, viz. sheep and bullocks, as suited me best at the time; but I think the best application of them is to fat sheep, who are to eat off the fresh-stocked part, and their leavings may be eaten by lean sheep that follow them, or yearling cattle, if the land be dry enough to bear them: when the land is damp and poachy, the turnips should be carted off for cattle to a dry piece of land, or a yard adjoining. The beasts should have hay or straw, as much as they will eat with them. Some years since, I made an experiment to ascertain what would be the difference of giving cattle hay or straw to eat with them. I took twelve beasts, in the same state of fatnefs, and which had been kept the preceding sum-

* By Mr. John Exter.

mer together, and tied them up in different yards. Six had hay with the turnips, and six had straw. The cattle fed with hay were finished and sold in May, the others in June. I have not repeated the experiment, as I was satisfied from this, that it would not pay to feed turnip stock on hay, if they are to go to grafs after. I find turnips of great use in rearing calves. I always give them as much hay as they will eat with them, and never permit them to drink, or give them any milk after I get them to eat turnips, which they generally take to at about ten weeks old.

I bring them to eat turnips, by keeping them twenty-four or thirty hours without any milk or water, and then cut the turnips into thin slices, and put some of them into their mouths; this soon brings them to pick them up from their mangers.

84. *On Raising Oaks*.*

It is a general received opinion, that when an oak loses its tap-root in transplanting, it never produces another; but this I have

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* By M. Forsyth.

proved to be a mistake, by an experiment which I made on a bed of oak plants, in the year 1789; I transplanted them into a fresh bed, in the forementioned year, cutting the tap-roots near to some of the small side-roots, or fibres, shooting from them. In the second year after, I headed one half of the plants down, and left the other half to nature. In the first season, those headed down made shoots six feet long and upwards, and completely covered the top of the old stems, leaving only a faint cicatrix, and had produced new tap-roots upwards of two feet and a half long. By this mode of treatment, they grow more in one year than in six when raised in the common way. The other half of the plants, that were not headed down, are not one-fourth of the size of the others. One of the former is now eighteen feet high, and, at six inches from the ground, measures fifteen inches in circumference; at three feet from the ground, ten inches; and at six feet, nine inches and a half; while one of the largest of the latter measures only five feet and a half high, and three inches and three quarters in circumference, at six inches from the ground. This is a convincing proof, that transplanting and heading down oaks is the most succesful and

advantageous way of treating them; and by it they are sooner out of danger from cattle, as well as from vermin, which are frequently very injurious to young trees.

85. *On the Age of a Horse*.*

This is easily known by his mouth, till he comes eight, after which the usual marks wear out. A horse, like many other brute animals, has his teeth divided into three ranks, viz. his foreteeth, which are flat and smooth, his tushes, and his back-teeth.—His back-teeth, or jaw-teeth, are called his grinders, being those by which a horse chews and grinds his provender, and are twenty-four in number, twelve above, and twelve below: they are strong double teeth with sharp edges; but when a horse grows old, they wear much smoother.

The first that grow are his foal teeth, which begin to appear a few months after he is foaled: they are twelve in number, six above, and six below; and are easily distinguished from the teeth that come afterwards, by their

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* By Mr. Thomas Boardman.

smallneſs and whiteneſs, not unlike the fore teeth of a man.

When the colt is about two years and a half old, he casts the four middlemost of his foal teeth, viz. two above and two below; but some do not cast any of their foal teeth till they are near three years old. The new teeth are easily distinguished from the foal teeth, being much stronger, and always twice their size, and are called the incisors or gatherers, being those by which a horse nips off the graſs, when he is feeding abroad in the fields, or, in the house, gathers his hay from the rack. When a horse has got these four teeth complete, he is reckoned three years old.

When he is about three and a half, or in the spring before he is four years old, he casts out four more of his foal teeth, viz. two above, and two below, one on each side the nippers, or middle teeth: so that when you look into a horse's mouth, and see the two middle teeth full grown, and none of the foal teeth, except the common teeth, remaining, you may conclude he is four that year, about April or May.

Some indeed are later colts, but that makes little alteration in the mouth.

The tushes appear near the same time with the four last-mentioned teeth, sometimes sooner than these, and sometimes not till after a horse is full four years old: they are curved like the tushes of other beasts, only in a young horse they have a sharp edge all round the top, and on both sides, the inside being somewhat grooved and flattish, inclined to a hollowneſs.

When a horse's tushes do not appear for some time after the foal teeth are cast, and the new ones come in their room, it is generally owing to the foal teeth having been pulled out before their time, by the breeders or other dealers in horses, to make a colt of three years old appear like one of four, that he may be the more saleable; for when any of the foal teeth have been pulled out, the others soon come in their places; but the tushes having none that go before them, can never make their appearance till their proper time, viz. when a horse is about four, or coming four; and therefore one of the surest marks to know a four-

years old horse, is by his tushes, which are then very small, and sharp on the top and edges.

When a horse comes five, or rather in the spring before he is five, the corner teeth begin to appear, and at first but just equal with the gums, being filled with flesh in the middle. The tushes are also by this time grown to a more distinct size, though not very large: they likewise continue rough and sharp on the top and edges. But the corner teeth are now most to be remarked; they differ from the middle teeth in being more fleshy on the inside, and the gums generally look rawish upon their first shooting out, whereas the others do not appear discoloured. The middle teeth arrive at their full growth in leſs than three weeks, but the corner teeth grow leisurely, and are seldom much above the gums till a horse is full five: they differ also from the other fore teeth in this, that they somewhat resemble a shell; and thence are called the shell teeth, because they environ the flesh in the middle half way round; and as they grow, the flesh within disappears, leaving a distinct hollowneſs and openneſs on the inside. When a horse is full five, these teeth

are generally about the thickneſs of a crown-piece above the gums. From five, to five and a half, they will grow about a quarter of an inch high, or more; and when a horse is full six, they will be near half an inch, and in some large horses a full half-inch, above the gums.

The corner teeth in the upper jaw fall out before those in the under, so that the upper corner teeth are seen before those below; on the contrary, the tushes in the under gums come on before those in the upper.

When a horse is full six years old, the hollowneſs on the inside begins visibly to fill up, and that which was at first fleshy, grows into a brownish spot, not unlike the eye of a dried garden bean, and continues so till he is seven; with this difference only, that the tooth is more filled up, and the mark, or spot, becomes faint, and of a lighter colour. At eight, the mark in most horses is quite worn out, though some retain the vestiges of it a long time; and those who have not had a good deal of experience, may sometimes be deceived by taking a horse of nine or ten years old for one of eight. It is at this time

only, when a horse is past mark, that one can easily err in knowing the age of a horse; for what practices are used to make a very young horse or colt appear older than he is, by pulling out the foal teeth before their time, may be discovered by feeling along the edges where the tushes grow, for they may be felt in the gums before the corner teeth are put forth; whereas, if the corner teeth come in some months before the tushes rise in the gums, we may reasonably suspect that the foal teeth have been pulled out at three years old.

It will, perhaps, be needleſs to mention the tricks that are used to make a false mark in a horse's mouth, by hollowing the tooth with a graver, and burning a mark with a small hot iron; because those who are acquainted with the true marks, will easily discover the cheat by the size and colour of the teeth, by the roundneſs and bluntneſs of the tushes, by the colour of the false mark, which is generally blacker, and more impreſsed than the true mark, and by many other visible tokens, which denote the advanced age of a horse.

After the horse has paſsed his eighth year, and sometimes at seven, nothing certain can

be known by the mouth. It must, however, be remembered, that some horses have but indifferent mouths when they are young, and soon lose their mark; others have their mouths good for a long time, their teeth being white, even, and regular, till they are sixteen years old and upwards, together with many other marks of freshneſs and vigour; but when a horse comes to be very old, it may be discovered by several indications, the constant attendants of age, viz. his gums wear away insensibly, leaving his teeth long and naked at their roots: the teeth also grow yellow, and sometimes brownish. The bars of the mouth, which, in a young horse, are always fleshy, and form so many distinct ridges, are, in an old horse, lean, dry, and smooth, with little or no rising. The eye-pits in a young horse (except those come of old stallions) are generally filled up with flesh, look plump and smooth; whereas in an old horse, they are sunk and hollow, and make them look ghastly, and with a melancholy aspect. There are also other marks which discover a horse to be very old, viz. grey horses turn white, and many of them all over flea-bitten, except their joints. This, however, happens sometimes later, and sometimes sooner, according

to the variety of colour and constitution. Black horses are apt to grow grey over their eye-brows, and very often over a good part of their face, especially those who have a star or blaze fringed round with grey when they are young. All horses when very old, sink more or leſs in their backs; and some horses, that are naturally long backed, grow so hollow with age, that it is scarce poſsible to fit them with a saddle. Of this kind are several Spanish and Barbary horses, and many of the Danish and Flanders breed. The joints also grow stiff with old age, and their knees and hocks bend so, that they are apt to trip and stumble upon the least descent, though the way be smooth, and no ways rugged. After which they can be of little use to the owner.

86. *On the Training and Pruning of Vines* *.

THE following is the method that I pursued with some vines which were planted against the piers of a south wall, and among old peaches, nectarines, plumbs, &c.

When I took them in hand, the fruit was so small and hard as to render it unfit to be sent

* By Mr. Forsyth.

to the table, The vines were trained upright, which caused them to grow so luxuriantly, that the sap flowed into the branches instead of the fruit.

In the year 1789, I let two strong branches grow to their full length without topping them in the summer. In 1790, I trained them in a serpentine form, leaving about thirty eyes on each shoot, which produced one hundred and twenty-five bunches of grapes, weighing from one pound to a pound and a quarter each. Every one that saw them said, that the large ones were as fine as forced grapes; while the small ones produced from branches of the same vine, trained and pruned in the old way, were bad natural grapes, and not above twice the size of large currants.

More fully to prove the succeſs attending this experiment, I next year trained five plants in the same way, allowing the shoots intended for bearing wood to run to their full length in summer, training them wherever there was a vacancy between the old trees; where there was none, I ran them along the top of the wall without topping them. In

winter, I trained them in a serpentine manner so as to fill the wall as regularly as pofsible: they were as productive as those in the former year.

After a three years trial, I thought I was warranted to follow the same practice with the whole; and in the year 1798 I sent, for the use of his Majesty and the Royal Family, 378 baskets of grapes, each basket weighing about three pounds, without planting a single vine more than were the preceding year, in which I was only able to send fifty-six baskets of the same weight, and those so bad and ill-ripened that I was ashamed of them, as they were not fit to be sent to the table.

In this year there was more than a quarter of the crop destroyed by birds and insects, and rotted by the wet.

Although the above treatment is within the bounds of truth, it may appear to some persons like an exaggeration; but it is in the power of every one who will follow the directions here given, to prove the advantage that will accrue from this method of training.

The above experiments were all made on the natural walls, and I hope will be sufficient to convince every unprejudiced person of the great advantage that the serpentine method of training vines poſsesses above the common way.

It may be proper to observe, that the shoots should be brought as near as poſsible from the bottom of the vine; that the wall may be well covered. When the walls are high, and the shoots from the serpentine branches strong, we sometimes let them remain; but if the walls are low, and the serpentine branches produce weak shoots, we cut them out in the autumnal pruning, and train up the strongest of the young wood in their room.

87. *On Lime* *.

Lime never increases the richneſs of any soil; but it has deteriorated much land by promoting an over exhaustion. Yet many landlords who, from supposing that it enriches the soil, make their tenants covenant to lime the land every time they fallow it; which is

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* By John Middleton, Esq.

generally every third year; not considering that it is a dreſsing mostly in favour of the tenant, and frequently against the interest of the landlord.

Landlords would therefore do well to restrain the general use of lime; and to give their tenants leave to apply it only where its beneficial effects are proved by experiment; and then for the production of two or three green crops to be fed on the land previously to taking *one* of corn. It seems to prepare the soil for yielding its treasures, and therefore if it should be applied for a succeſsion of corn crops, the ruin of the land is inevitable.

83. *On Paring and Burning* *.

The impropriety of breaking up tough, wiry, benty, and heathy land, without paring and burning, is manifested in the neighbourhood of Beach-hill, where land, after twenty years inclosure and cultivation, is in a worse state now than it was originally. It would be well for the owners of such allotments, if they could now pare and burn them; but they

* By John Middleton, Esq.

have been ploughed, and not producing much more than what the vermin destroyed, laid down in such a rough state to grafs, as to be incapable of being pared and burnt. The original wiry, bent, and dwarf shrubs, are now growing in full vigour. On whatever soil paring and burning has been practiced, it has never failed of advancing the land to the first degree of fertility; and he must be a very bad farmer who cannot continue, for any length of time, land so enriched, in a high state of productiveneſs. The particular arguments brought against this practice, totally fail in proving that paring and burning is in the smallest degree of an impoverishing nature; but they demonstrate the ruinous practice of a succeſsion of corn crops, and the neceſsity of strong covenants, and watchful attention on the part of the landlord, to their due execution, in order to secure the land against being exhausted.

Farmers who are induced from theoretical arguments to prefer the plough to paring and burning, will find their land to become too light and spongy for any crop; even rolling cannot keep it down; for its elasticity raises the soil soon after the roller has paſsed over

it, and it is of so imperishable a nature, that it is likely to plague the farmer for many years. The one method immediately opens a source of great profit; whereas the other leads to nothing but expense and disappointment.

89. *On Hogs**.

The largest breed in Britain is supposed to be kept in the neighbourhood of Rudgewick, on the borders of Surrey and Sussex, which, at two years old, feed to an astonishing weight, even to double, or treble the weight of most hogs at that age. This breed deserves to be extensively known, and the number of them increased in most parts of this island, as they are likely to pay much more for their feed than other breeds of a smaller kind. The following are the weights of some hogs at Rudgewick.

The largest was fatted by Mr. Thomas Ireland, and killed by John Oulder, at Wisborrow Green; it weighed one hundred

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* By Mr. James Puttock.

and sixteen stone, six pounds. Two more were fatted by Mr. Ireland, and killed at his house: one ninety-three stone, and one eighty stone. Mr. Edward Ireland, one eighty-six stone, and one eighty stone. Mr. Thomas Elliott, one of ninety-seven stone, and one ninety stone; this had eighty-eight pounds in the flea. Mr. Parkhurst Elliot, one eighty stone; and Mr. Anthony Widden, one ninety-nine stone. Mr. Stening, one eighty-five stone. Mr. Pryde, of Cronley, one, last year, ninety-one stone; and several more that weighed between seventy and eighty stone, of which I take no notice. The hogs were about two years old.

I conceive that the London stone of eight pounds is here meant. A. H.

90. *On feeding Horses*.*

CUTTING straw, clover, or hay, and mixing them with the horse-corn, is a great saving in stover; but in the county of Kent, where they cut all the provender for their horses, they have a practice much to be com-

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* By A. Collet, Esq.

mended. It is their custom, in the month of April, or sooner, if the season permits, to cut every day a small quantity of green rye, to be mixed with the corn and chaff. Every farmer knows that in the spring, many horses pine and look sickly for want of green food; and if the weather be dry and hot at the same time, many horses will not eat dry meat without being watered. Half an acre of rye, sown the latter end of September, will be sufficient for ten or twelve horses till they go out to grafs. Lucern will come in to cut as early as rye, and is preferable. I am convinced that whoever tries this *once*, will never leave off the practice.

91. *On Sagaciousnefs, sharpened by early neceſsity, in opposition to the effects produced by toys and playthings given to the children of the rich**.

It is the poor alone who are permitted to feel and to enjoy the rich provision made by nature for their instruction in its full extent. Accordingly we shall find that the children of peasants of the lowest clafs, nay even the children of gipseys, have at three years of age,

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* By Miſs Eliz. Hamilton.

a greater stock of ideas, acquired from the examination of sensible objects, and are infinitely more capable of taking care of themselves, than children of the higher ranks at six.

On a woody and steep declivity of the Cotteswold hills, where they project into the vale of Gloucester, stands a small cot inhabited by a poor widow, or rather a deserted wife, who was left with two infants, for whose provision she exerted herself in the labours of the field; and being a woman of remarkable strength and dexterity, she found employment with the neighbouring farmers. Soon as her youngest boy was weaned, she consigned him to the care of his brother, only three years of age. After having cut the brown bread which was to supply them with food for the day, and given necefsary instructions to the older boy, who was to act as cook, housekeeper, and nurse, she left them generally about five in the morning, and seldom returned till night. At the time I first saw this little pair (which I did every day for weeks together when on a visit to a family in the neighbourhood,) the eldest was near five, and the

youngest about two years of age. Each might have sat for the picture of an infant Hercules. By living almost constantly in the open air, they had acquired a degree of hardineſs and vigour, seldom to be met with at that early age; and by experience had become so well acquainted with the objects around them, and with the nature of every danger to which they were exposed, that though often on the edge of precipices which would make a fine lady shudder with horror, and where a fine little master would probably have broken his neck, I never heard of their meeting with the smallest accident. When the hours of meal arrived, the elder, who never for a moment forsook his little charge, took him into the cot, and seating him in a corner, proceeded to make a fire with sticks, which he managed with great dexterity.

The brown bread was then crumbled down, boiled with water, and sweetened with a very little coarse sugar. This plain, but evidently from its effects, wholesome meſs, he then placed on the floor, and sitting down betwixt it and his brother, gave him alternate spoonfuls with himself till all was finished.

"Take care, Dan," said a lady who once happened to step into the cottage at the beginning of this operation, "take care that you "don't scald your brother's mouth." "No fear "of that," returned the boy, "for I always "takes *un* first to self."

92. *On Woollen Rags.*

At London, and other considerable cities, there are people who make it their employment to collect woollen rags, chop them in small pieces, and sell them either by the sack, or the hundred weight. They are used on the dry sands of Hertfordshire with great effect in dry seasons, which may be attributed to to their power of attracting moisture from the atmosphere. However, being an animal substance, capable of putrefaction, we must suppose that they act also by yielding the food of plants.

93. *Income of the Kingdom.*

Whenever it shall please God to influence this nation to perform the patriotic exertion recommended in Essay XI, page 155, of this Volume, it will be a great satisfaction to

know that Great Britain is fully adequate to the virtuous task. A. H.

	£
Rents of Land	40,000,000
Profits of Farming	35,000,000
Amount of Tithes	4,000,000
Income from Money in the Public Funds	17,000,000
From Money in Bonds and Bills, including capitals in Banks	10,000,000
From Rents of Houses	4,000,000
From Canals, Mines, and Fisheries	5,000,000
Incomes spent in Britain, arising from Property in other Countries	5,000,000
From the Retail Trade, over the Nation	12,000,000
From the capital employed in Domestic Trade	28,000,000
Incomes of Manufacturers and others, from 15 l. to 60 l. a year	75,000,000
	* £235,000,000

94. *On Drawing Turnips*†.

It is a fact which every one will admit, that turnips drawn and spread in a grafs field, will go much farther than when consumed on the land where they grew: from my own observation, there is near one-third difference.

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* By Benj. Bell, Esq.

† By Mr. John Tuke.

Where turnips are much cultivated, it is now become the general practice to sow grafs-seeds with the crop of corn which follows them, if the land is of pretty good quality, and has been well manured for the turnips. If a good crop of these has been obtained, the consumption of them on the land will make it so rich, that the succeeding crop of corn will be greatly injured by running too much into straw, and by being laid; and the clover, or seeds, sown with it, to be thereby very much injured: but if the turnips were drawn, and regularly consumed in a field which was sown with seeds, either in the last year or the year before, that inconvenience would be removed. The additional quantity of ſtock they would keep, would compenſate for the expenſe of drawing and carriage; the land would be more benefitted by a larger number of ſtock being kept, and they would make a greater improvement by being regularly ſerved every day, having their food clean, and lying cleaner themſelves, than when put on a piece of turnips, which after the few firſt days become ſoiled, not only by their feet, but alſo by their dung and urine, in which ſtate, nothing but hunger will induce them to eat ſuch uncleanly food; and from their eagerneſs for that which is freſh, ariſes the difficulty of preventing

sheep from breaking out of their fold into the fresh turnips, where they do great damage.

95. *On Cottagers renting Land, or enjoying small Freeholds*.*

HAVING lived more than thirty years in a country village, I have had innumerable occasions to remark a striking difference between the cottagers, who have a garden adjoining to their habitations, and those who have no garden. The former are generally sober, industrious, and healthy, whilst the latter are too often drunken, lazy, vicious, and frequently diseased. The reason for this difference is obvious, because one fills up all his time with useful labour, whilst the other, for want of occupation, takes refuge in the alehouse, where he dissipates his scanty pittance, and destroys his health.

Another striking difference to be noticed, is between those who have freehold tenements, and their neighbours, who are obliged to rent. In the former we commonly observe that openness and honesty, which are seldom to be seen in men who are destitute of property. The peasant, whose ancestors built a

* By the Rev. J. Townsend.

cottage on the waste, with a sufficient garden, and the right of commonage for his cow, if he retain this little patrimony, brings up a numerous family without being reduced to the neceſsity of asking aſsistance from his parish. This man acquires habits of sobriety and industry, and his property is a pledge to the community for his good behaviour. These good qualities are transmitted to his offspring; and when his children go out to service, they, like their parents, are distinguished for ingenuous conduct; they resemble the sons of freemen, whilst the immediate descendants of those, who have no freehold, too frequently have all the dispositions of a slave.

Commons, it must be acknowledged, if not stinted, starve all cattle; and though stinted, yet cannot be improved, like land that is in severalty. They have this advantage to the poor man, that his property is inalienable, and must descend from the father to his son. Commons, however, should never be admitted in a well regulated state, and when divided, the rights and interests of the cottager should be particularly attended to.

The cottage law of Queen Elizabeth, which

required that four acres of land should be attached for ever to each cottage, precluded the neceſsity of commons. This statute has been repealed. Four acres of land were too much for the spade, and too little for the plough, and therefore it was wise in the legislative authority, at a time when pasture gave place to tillage, to abrogate this law. Yet, perhaps, it would have been more advisable merely to have leſsened the quantity of land required for each cottage, than to have dropped this provision altogether.

At the present moment, when it is in contemplation to improve the wastes, and to inclose all commons, would it not be prudent to allot a certain portion of land, perhaps one-eighth of an acre, to each cottage, with a provision, that this little property should be inalienable, and rather go to the most distant relation, than to one who is poſseſsed of land?

Such a provision has been made by Spain in the new settlements of the Sierra Morena, and is found beneficial to the public.

Even in parishes, which have already laid

all their common lands in severalty, without making the provision here recommended for the poor, might it not be advisable to give every cottager employed in agriculture, the same quantity of land, on the same conditions as above?

A parish containing three thousand acres of arable and pasture, in proportion to each other, may be cultivated by one hundred families, who, according to this proposal, would require only twelve acres and a half of land to make them happy. This, at 40s. per acre, would cost the parish only 25l. per annum, whilst in cabbages, carrots, and potatoes, it would produce the value of more than 300l. a year, which produce would undoubtedly relieve the poor rates to the same amount.

The West India planters have adopted a plan somewhat similar to this, and derive from it the most substantial advantages; for by this they encourage industry, and in the most agreeable manner induce their slaves, by strenuous exertions, to derive profit from every moment of their time.

96. *On the Corn Trade* *.

THE corn trade, both as a manufacture, and an article of commerce, is, of all others, of the greatest importance to the prosperity of the kingdom.

Abundance of grain at home, and at a moderate price, can only be obtained, and secured, by giving such liberal encouragement to exportation, as may render the raising of corn the favourite object of industry in the kingdom. Thus, instead of purchasing a considerable part of our subsistence from foreign countries, we may, by extending the sale of corn to them, increase the demand; and by cultivating the waste lands, be enabled not only to supply ourselves, but to render our country one of the principal granaries of Europe. It is clear that Great Britain, under proper laws, is capable of increasing her growth of corn to any degree for which demand can be obtained. This being the case, open the ports for exportation, and the demand would be almost unlimited; allow the commons to be cultivated under a general

* By John Middleton, Esq.

inclosure bill, and the supply would be certain.

What greater injury can be done to this kingdom, than by suffering upwards of twenty-two millions of acres of land to lie uncultivated. True policy says, that we should cultivate and bring into use every capable inch of this island; and by exporting such parts of the produce as would not be wanted for home consumption, increase the riches and commerce of the nation. On the contrary, the present narrow policy* of this

* A General Inclosure Bill, with a *Compulsory* Act for the Commutation of Tithes, would effectually remove the grievances here so justly complained of. The millions that, but a few years ago, were sent out of this country for corn, ought to rouse the dormant good sense of the British Legislature. The church may complain of a compulsory act, but the general good of the nation, together with the high importance of religion and morality, ought to outweigh every other considerarion. I do not wish to be thought as objecting to tithes, for they are the legal right of the church, but I object to the mode of collection. The farmer who earns his living by hard labour, will not be cordially induced to receive religious instruction from the man who is rigorously exacting the tenth of his labour, without so much as assisting in wiping off the sweat from his brow.

A. H.

country, makes it impoſsible for husbandmen to provide small farms for their children to cultivate, which neceſsarily drives them into trade; checks and repreſses matrimony, and consequently keeps down the most healthy, vigorous, and useful claſses of population. It is likewise the cause of our manufacturers being fed, at a very increased price, with the productions of the land of other nations, who are occasionally our enemies, but who have the superior wisdom to raise corn for exportation, and consequently to drain this country of its wealth, to pay them for their labour and profit in raising it.

97. *The Method of making Butter in Holland*.*

HAVING milked the cows, the milk is not put into the pans till it is quite cold; it is then stirred two or three times a day, with a wooden spoon, to prevent the cream from separating from the milk; and if it can be stirred till the spoon will almost stand in it, they deem it so much the better. When it is found to be sufficiently thick, it is put into the churn and beat for an hour. When the

* By Mr. R. Pole Carew.

butter begins to form, a pint, or more, of cold water, according to the quantity of milk, is poured in, to separate the butter from the butter-milk. When the butter is taken out of the churn, it is washed and kneaded till the last water is perfectly clear and free from milk. By this method, a greater quantity of butter is made from an equal quantity of milk; and the butter is more firm and sweet, and will keep longer than that which is made by the method commonly in use in England; and the butter-milk which remains is thought preferable.

93. *On fastening the roots of Wheat*.*

After a frosty winter, the crown roots of wheat, on some lands, are thrown out of the ground, the best remedy for which, is to drive a flock of sheep into the field, after a moderate shower. These with their feet will fasten the roots much better than the roller, but it will be necessary to drive the flock about, without suffering the sheep to feed upon the corn. After the flock is driven off, there can be no objection to passing a light roller over the land.

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* By Mr. William Brown.

99. *On Lime* *.

LIME is not capable of increasing the richneſs of any ſoil. It only prepares the ſoil for yielding its treaſures, and, therefore, good huſbandry requires that it ſhould never be applied *alone* for a ſucceſſion of corn crops; yet many landlords, who, from ſuppoſing that it enriches the ſoil, make their tenants covenant to lime the land every time they fallow it, which is generally every third year, not conſidering, that when uſed alone, it is a dreſſing moſtly in favour of the tenant, and frequently againſt the intereſt of the landlord. Inſtances are not wanting to prove the miſerable ſtate that land is often left in by a greedy and diſhoneſt tenant, who, by means of lime, and a ſucceſſion of corn crops, has extracted from it the laſt particle of nouriſhment, leaving the farm to be reſtored to its former energy, at a great expenſe, by the landlord himſelf.

100. *On Meadow Land in the occupation of Cowkeepers in the neighbourhood of London* †.

MEADOW land in the occupation of Cow-

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* By A. Hunter, M. D.

† By John Middleton, Eſq.

keepers, is generally mown two or three times in a summer. Their great number of cows enable them to dreſs it every year, and they are studious to procure their hay of a soft graſsy quality, not letting it stand till the seedling stems rise, but mowing it two, three, or four weeks sooner than it would be advisable to do for the support of horses.

"Persons who keep cows upon hay grown upon lands liable to river-floods, would do well to attend to the above practice."

A. H.

ESSAY XIII.

On Farm-yard Management.

IT is not sufficient to attend to the general theory of agriculture, for however scientifically this may be studied, unleſs the minutiæ of the practice be indefatigably observed, the system of husbandry must remain incomplete. Of the leſser branches of this art, one of the most considerable and of the greatest importance, is the good order and economy of the farm-yard. To raise the most valuable and largest quantity of manure, should be the great object of every farmer; upon this circumstance, the vigour and health of his land will principally depend. Every thing, therefore, that can contribute in the smallest degree to the size or quality of the dung-hill, is of the utmost consequence.

For this purpose, I should recommend farmsteads to be built with every requisite convenience, which, by attending to the real utility, rather than the appearance of the build-

ings, may be done at a moderate expense. The tenant can amply afford a proper rent for such conveniences, and it is very much to his interest, as well as to that of the landlord, to have them. Grazing farms which do not produce great quantities of straw, require to be better accommodated with sheds and houses for cattle than large arable farms; as upon the latter, economy of straw cannot be so closely attended to. The yard will be found more convenient, if divided into two parts; as it is always desirable to separate the younger stock from those that are older; so circumstanced, they are more at rest, and consequently thrive better. One pump will water both yards, which is far preferable to the old mode of permitting the cattle to go to an adjoining pond to water, by which a great quantity of manure is lost, and much ground poached by their feet. The yard should form altogether a shallow basin, to preserve the liquid part of the manure; and it will be found very advantageous to lay at the bottom a considerable quantity of sand, or any absorbent upper soil. This should be done every spring and autumn, when the cattle are confined *all* the year; but if they are only taken up in the winter, once will be sufficient: each

time the yard is cleared of the dung, a very large portion of highly valuable manure for grafs land, will be obtained from the bottom of the farm-yard, which may be again replenished with sand or earth. It is not within the limits of a short Efsay, like the present, that all the advantages of this mode can be pointed out, the value of it can alone be ascertained by those who have practised it. The increased quantity of manure is very great, all the superfluous moisture is absorbed by it, and the farm-yard is kept in a much drier, and more comfortable state than it otherwise could be, particularly where attention is paid to the value of straw. But I admit that there are situations, where, from the difficulty of procuring proper materials, this system can be only partially observed.

As soon as, from the severity of the weather, or bareneſs of the pastures, it is thought neceſsary to fodder the cattle, I should recommend them to be brought into the farm-yard, in preference to giving them hay or turnips whilst out. The cattle will be much better sheltered, and a larger quantity of manure will be made. Experience convinces me, that the dung of animals laid upon the ground at

any season of the year, in its unfermented state, does not by any means enrich the land so much as when it has undergone a quick fermentation, with a small quantity of litter. Let as many cattle be tied up in houses or sheds as the buildings will admit of, particularly the fattening beasts. Cows and calves thrive better and require lefs meat in the house, than when exposed to all changes of weather in the farm-yard; the waste is not near so great, and consequently the manure is improved by the straw being eaten, rather than trodden down into litter. I have before said, that the great object of the farmer should be to keep the largest pofsible stock of every kind of cattle, to augment and improve his dunghill: I would therefore have every care taken to make the straw go as far as it can; and I speak of straw more particularly, as I do not consider hay, in general, a profitable crop for the farmer. When we observe the common method of using straw, it is not to be wondered at, that it should be undervalued; it is too frequently and injudiciously made the sole food of cattle, which (especially when coarse and ill-gotten) they show by their daily decrease of condition; an obvious circumstance, that it does not afford them sufficient

nutriment: such cattle, in the spring, are turned from the farm-yard to graſs, in so poor a state, that two or three months are often neceſsary to get them again into the same condition they were in when taken up in the autumn. This proves a severe check to the young cattle, which it very materially injures, and is a great drawback on the farmer's profit. But let straw be made subservient to turnips, carrots, cabbages, kale, potatoes, &c. Let a certain portion of these crops, according to the nature of the farm, be given to the cattle, and a very large quantity of winter stock will be kept in a progreſsive state of improvement: which, upon all soils, will prove exceedingly profitable. I believe it will ever be found for the interest of the farmer, to keep all his stock in high condition, more particularly young animals, as they will come sooner to profit, and are at all times saleable; it is well known that animals when fat, consume much leſs food than when in a lean state.

I have paid great attention to the nutritious qualities of the turnip, not only in the feeding of cattle, but of horses and store pigs; all of which I find to thrive exceedingly well upon them in their raw state. It has been my

practice to give my draught horses about a peck and a half of turnips each, every night, with a fodder of straw; and I am of opinion, that they thrive as well, and keep in better health by this mode, than they would do upon the best hay. The turnips are given to them whole, but without the tops and fangs. On land where they draw clean, and in dry weather, they will not require washing; but if dirty, they must be washed; this, however, is seldom the case with me. In the day time, whether worked or not, they have hay and a small quantity of corn, with sometimes an addition of a few carrots in the stable; but on days of rest, they are turned into the farm-yard for two or three hours, where they enjoy the turnips with the cattle. By these means, my draught horses are kept in good condition, at a comparative small expense, and a great consumption of corn is avoided; their bodies are temperate, and their legs are constantly clean. My cattle have turnips in proportion to their respective conditions and ages; but all have some, and are thereby kept in a state of improvement; my general plan is, to let them all out into the farm-yard, about four hours during the finest part of the day, at which time, they all eat turnips, having straw only

in the house, excepting the cows, calves, and those cattle which are fattening. Even my pigs, which are of the Scotch and Leicester breeds, eat turnips in considerable quantities; I find them answer very well for store pigs, with the addition of the little other meat they pick up in the yard.

The value of turnips, as food for sheep, has long been fully allowed. For cattle too they are gaining ground considerably, but I think are generally given only to such as are fattening, and to cows and calves. Store cattle are much neglected in the winter season; I have met with very few farmers who have made turnips a common food for their draught and young horses; or who have considered them valuable as food for pigs; but from my own experience, I venture strongly to recommend them for these purposes; at first, perhaps, they will object to them. In a few days they will eat them a little, and when some begin to feed upon them, all the rest will quickly follow the example.

The Ruta Baga I have heard recommended as far superior for these latter purposes; and am inclined to think, from the closeneſs of its

texture, and its sweetneſs, that it is more nutritious; but I have not been succeſsful in raising a good produce; it appears to me to be a very precarious crop. I propose, however, to give it a farther trial; and should be sorry to say any thing that might tend to discourage the cultivation of a plant poſseſsed of so many valuable properties. Carrots, cabbages, and kale, I consider as highly necessary crops upon all farms; the two latter particularly so upon strong soils; they are an excellent resource in long frosts and deep snows, when turnips are with difficulty procured. It is desirable to grow them as near the homestead as poſsible. I find the method of preserving turnips from the frost, as mentioned by Mr. Marshall in his "Minutes of Agriculture," page 109, of great use, as a constant supply is thereby provided, notwithstanding the weather. Before the frost sets in, I employ boys to aſsist my own labourers in cutting off the tops and fangs; the tops are carted home for the immediate use of the cattle, or spread upon graſs land for the sheep. The bulbs are thus preserved; a layer of straw is spread in a round form upon a dry part of the land, and the turnips are carted to it; four or five loads are heaped and

covered with straw; a little earth is put at the top, in the manner of potatoes; only as they seldom lay long, quite so much care is not neceſsary. Thus they remain until a frost causes a demand for them in the farm-yard, at which time they are particularly serviceable, if they are led home without injury to the land or roads. They might also be protected thus for sheep, which would greatly leſsen the consumption of hay in severe weather.

Corn, in the straw, I have cut in small quantities, and think it is very useful to give to horses in the day time when it is required to have them fed quickly, that they may get to work again; but I am of opinion where chaff is plentiful, much of this will not be required.

ESSAY XIV.

On the Yew Tree.

WE have but one species of this tree growing in Europe, viz.

TAXUS (baccata) foliis approximatis. Lin. Sp. Plant. 1472. *Yew tree with leaves growing near each other.* THE YEW TREE.

It is of the clafs and order *Dioecia Monadelphia.* *a.* A male flower. A. Ditto, magnified. B. the Calyx, magnified. D. the Stamina, magnified. E. Two Stamina, magnified, one viewed in front, the other on the under side. *f.* The female flower, F. Ditto magnified. G. The Calyx, magnified. *I.* The Embryo, with its Pointal. *k.* The fruit, or berry. *l.* A vertical Section of Ditto. *m.* The Seed.

The Yew-tree grows naturally in England, and also in most of the northern countries of Europe. If suffered to grow, it will rise to a good height, with a very large stem. It naturally sends out branches on every side,

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which spread out, and are almost horizontal; these are closely garnished with narrow, stiff, blunt-pointed leaves, of a very dark green. The flowers come out from the sides of the branches in clusters; the male flowers having many stamina, are more conspicuous than the female; these, for the most part, are upon different trees, but sometimes are upon the same tree; they appear the latter end of May, and the berries ripen in autumn.

This tree has been generally cultivated for the pleasure-garden, to be clipped into the shape of beasts, birds, &c. or for hedges. Whoever is pleased with such figures, can raise no tree more proper for the purpose, as the branches and the leaves may be clipped and fashioned into almost any form or shape. But as this method is justly exploded, and as every one who has the least pretension to taste, must always prefer a tree in its natural growth to those monstrous figures, the Yew is now chiefly planted for wilderneſs quarters, and for hedges, for which service it is excellently well adapted, as no tree bears clipping so well.

These trees may be easily propagated by

sowing their berries in autumn, as soon as they are ripe, or in the spring, upon a shady bed of fresh undunged soil, covering them over about half an inch thick with the same earth.

The bed must be carefully cleared from weeds, and if the season prove dry, it will be proper to refresh it with water now and then, which will promote the growth of the seeds, some of which will come up in spring, but the greatest part will remain in the ground until autumn or the spring following.

The plants, when they come up, should be constantly cleared from weeds, which, if permitted to grow amongst them, will cause their bottoms to be naked, and frequently destroy the plants when they continue long undisturbed.

In this bed the plants may remain two years; after which, in autumn, there should be a spot of fresh undunged soil prepared, into which they should be removed the beginning of October, planting them in beds about four or five feet wide, in rows about a foot asunder, and the same distance from each other in the rows, observing to lay a little mulch upon the

surface of the ground about the roots, as also to water them in dry weather until they have taken root; after which they will require no farther care, but to keep them clear from weeds in summer, and to trim them according to the purposes for which they are intended.

In these beds they may remain two or three years, according as they have grown, when they should again be removed into the nursery, placing them in rows at three feet distance, and the plants eighteen inches asunder in the rows; observe to do it in autumn, as was before directed, and continue to trim them in the summer season, according to the design for which they are intended; and after they have continued three or four years in the nursery, they may be transplanted where they are to remain; always observing to remove them in autumn when intended for dry ground, but for cold moist land the spring is the better season.

These trees, though of slow growth, do sometimes arrive at a considerable size. Mr. Pennant mentions one in Fontingal churchyard, in the Highlands of Scotland, whose ruins measured fifty-six feet and a half in circumference.

Of the Yew there is a variety with short leaves, which appears very ornamental in plantations. There is also another with striped leaves, of great value amongst the variegated tribes. These are increased by layers, but the striped sort must be planted upon a barren soil, otherwise it will become plain.

In the days of Archery, so great was the demand for the wood of the Yew-tree, that the merchants were obliged by statute to import four staves of it for every ton of goods coming from places where bow-staves had formerly been brought. In those ancient days the Yew was planted in church-yards, where it stood a substitute for the *Invisa Cupreſsus*. It also was placed near houses, where it might be ready for the sturdy bows of our warlike Ancestors,

——————————— " who drew,
" And almost joined, the horns of the tough Yew."

Mr. Pennant informs us that this tree is to be found in its native state upon the hills that bound the waters of the Winander, and on the face of many precipices of different places in this kingdom. There are six remarkable trees of this sort now growing on the hill

above Fountain's Abbey, near Ripon, which, in 1770, measured in circumference as below:

	Feet.	In.		Feet.	In.
1	13	0	4	21	0
2	18	0	5	25	0
3	19	0	6	26	6

Under these very trees a number of Monks resided, until they built the Monastery of Fountains in 1133, having withdrawn themselves from the Benedictine Monastery of St. Mary in York.

The best reason that can be given why the Yew was planted in church-yards, is, that branches of it were often carried in procesion, on Palm Sunday, instead of the Palm. The following extract from Caxton's Direction for keeping feasts all the year, is decisive on this custom. In the lecture for Palm Sunday, he says, "Wherefore Holy Chirch this day makyth solemn procesyon, in mind of the procesyon that Cryst made this day. But for encheson that we have none Olyve that bereth grene leef, algate therefore we take Ewe instede of Palm and Olyve, and beren about in procesyon, and so is thys day called Palm Sonday." As a confirmation of this fact,

the Yew trees in the church-yards of East Kent are at this day called Palms.

My most excellent and learned friend Dr. Percival of Manchester, in his "Medical and Philosophical Esays," has recorded a melancholy proof of the poisonous quality of Yew leaves. "On Friday, March 25, 1774, three children of James Buckley, a labouring man at Longsight, near Manchester, were killed by taking a small quantity of the fresh leaves of the Yew-tree, or *Taxus Officinalis* of Caspar Bauhine. The oldest child was five, the second four, and the youngest three years of age: They were all supposed to be infected with the worms, and this poison was given them by the recommendation of some ignorant person, as a powerful remedy for that disorder. The *dried leaves* were first employed; and a spoonful of them, mixed with brown sugar, was divided into three equal dozes, which the children took at seven o'clock in the evening. At eight they had each a mess of pottage, prepared of butter-milk, which, having been kept several days, was become very sour. No complaints were made by the children; nor did any bad effects ensue. Two days afterwards the mother collected *fresh*

leaves, and administered them in the same dose, as before, and at the same hour. At eight o'clock the children breakfasted on nettle-pottage, that is, oatmeal gruel with fresh nettles boiled in it, a mefs well known in this country. At nine, they began to be uneasy; were chilly and listlefs: yawned much; and frequently stretched out their limbs. The oldest vomited a little, and complained of gripings in his belly; but the others expreſsed no signs of pains. The second child died at ten o'clock; the youngest about one; and the oldest at three in the afternoon. No agonies accompanied their diſsolution; no swelling of the abdomen ensued; and after death they had the appearance of being in a placid sleep. These particulars I learned from the unfortunate parents of the children, whose ignorance led them too long, and too fatally, to rely on the trifling and inefficacious means of relief, suggested to them by their neighbours.

ESSAY XV.

On Hay-making.

THIS branch of the rural art has, by the farmers of Middlesex, been brought to a degree of perfection altogether unequalled by any other part of the kingdom. The neat husbandry, and superior skill and management, that are so much, and justly, admired in the *arable* farmers of the best cultivated districts, may, with equal justice and propriety, be said to belong, in a very eminent degree, to the *hay* farmers of Middlesex: for by them, may very fairly be claimed the merit of having reduced the art of making good hay to a regular system; which, after having stood the test of long practice and experience, is found to be attended with the most desirable success. Even in the most unfavourable weather, the hay made according to the Middlesex manner, is superior to that made by any other method, under similar circumstances. It is to be regretted, that this very excellent practice has not yet, except in a very few instances,

travelled beyond the borders of the county. But as it most justly deserves the attention and imitation of farmers in other districts, I shall, for their information, endeavour minutely to describe the method in which the Middlesex farmers make their hay.

In order that the subject may be more clearly understood, I shall relate the particular operations of each day, during the whole procefs, from the moment in which the mower first applies his scythe, to that in which the hay is secured either in the barn or in the stack. Before I enter more immediately on this task, I would just premise a few observations, viz. when the grafs is nearly fit for mowing, the Middlesex farmer endeavours to select the best mowers, in number proportioned to the quantity of his grafs, and the length of time it would be advisable to have it in hand—which having done, he lets it out, as piece work, or to be mown by the acre.

About the same time he provides five haymakers (men and women*) to each mower.

* Including loaders, pitchers, and stackers, and all others.

These last are paid by the day—the men attending from six till six; but the women only from eight till six:—for an extra hour or so in the evening, when the business requires despatch, they receive a proportionate allowance.

The mowers usually begin their work at three, four, or five o'clock in the morning, and continue to labour till seven or eight at night; resting an hour or two in the middle of the day.

Every hay-maker is expected to come provided with a fork and a rake of his own; but when the grass is ready, and labourers scarce, the farmer is frequently obliged to provide both; but for the most part only the rake.

Every part of the operation is carried on with forks, except clearing the ground, which is done with rakes; and loading the carts, which is done by hand.

Having premised so much, I now come to the description of the business of the

First Day.—All the grass mown *before* nine o'clock in the morning, is tedded (or spread)

and great care taken to shake it out of every lump, and to strew it evenly over all the ground. Soon afterwards it is turned, with the same degree of care and attention; and if, from the number of hands, they are able to turn the whole again, they do so, or at least as much of it as they can, till twelve or one o'clock, at which time they dine. The first thing to be done after dinner, is to rake it into what are called *single* windrows*; and the last operation of this day is to put it into grafs-cocks.

Second Day.—The buſineſs of this day commences with tedding all the graſs that was mown the first day *after* nine o'clock, and all that was mown this day *before* nine o'clock. Next, the graſs-cocks are to be well shaken out into staddles (or separate plats) of five or six yards diameter. If the crop should be so thin and light as to leave the spaces between these staddles rather large, such spaces must be immediately raked clean, and the rakings mixed with the other hay, in order to its all

* That is, they all rake in such a manner, as that each person makes a row, which rows are three or four feet apart.

drying of a uniform colour. The next business is to turn the staddles, and after that to turn the grass that was tedded in the first part of the morning, once or twice, in the manner described for the first day. This should all be done before twelve or one o'clock, so that the whole may lie to dry, while the work-people are at dinner. After dinner, the first thing to be done is, to rake the staddles into *double* windrows*; next, to rake the grass into *single* windrows; then the double windrows are put into bastard-cocks; and lastly, the single windrows are put into grass-cocks. This completes the work of the second day.

Third Day.—The grass mown and not spread on the second day, and also that mown in the early part of this day, is first to be tedded in the morning; and then the grass-cocks are to be spread into staddles, as before, and the bastard-cocks into staddles of less extent. These lesser staddles, though last spread,

* In doing which, every two persons rake the hay in opposite directions, or towards each other, and by that means form a row between them of double the size of a single windrow. Each of these double windrows are about six or eight feet distant from each other.

are first turned, then those which were in grafs-cocks; and next the grafs is turned once or twice before twelve or one o'clock, when the people go to dinner as usual. If the weather has proved sunny and fine, the hay which was last night in bastard-cocks, will this afternoon be in a proper state to be carried*; but if the weather should, on the contrary, have been cool and cloudy, no part of it probably will be fit to carry. In that case, the first thing set about after dinner, is to rake that which was in grafs-cocks last night into double windrows; then the grafs which was this morning spread from the swaths, into single windrows. After this, the hay which was last night in bastard-cocks is made up into full-sized cocks, and care taken to rake the hay up clean, and also to put the rakings upon the top of each cock. Next, the double windrows are put into bastard-cocks, and the single windrows into grafs-cocks, as on the preceding days.

Fourth Day.—On this day the great cocks, just mentioned, are usually carried before din-

* It seldom happens in dry weather, but that it may be carried on the third day.

ner. The other operations of the day are such, and in the same order, as before described, and are continued daily until the hay harvest is completed.

In the course of hay-making, the grafs should, as much as poſsible, be protected both day and night, against rain and dew, by cocking. Care should also be taken to proportion the number of hay-makers to that of the mowers, so that there may not be more grafs in hand, at any one time, than can be managed according to the foregoing proceſs. This proportion is about twenty hay-makers (of which number twelve may be women) to four mowers: the latter are sometimes taken half a day to aſsist the former. But in hot, windy, or very drying weather, a greater proportion of hay-makers will be required, than when the weather is cloudy and cool.

It is particularly neceſsary to guard against spreading more hay than the number of hands can get into cock the same day, or before rain. In showery and uncertain weather, the grafs may sometimes be suffered to lie three, four, or even five days in swath. But before it has lain long enough for the under

side of the swath to become yellow (which, if suffered to lie long, would be the case), particular care should be taken to turn the swaths with the heads of the rakes. In this state it will cure so much in about two days, as only to require being tedded a few hours, when the weather is fine, previous to its being put together and carried. In this manner, hay may be made and stacked at a small expense, and of a good colour; but the tops and bottoms of the grafs are insufficiently separated by it.

There are no hay-stacks more neatly formed, nor better secured, than those of Middlesex. At every vacant time, while the stack is carrying up, the men are employed in pulling it, with their hands, into a proper shape; and, about a week after it is finished, the whole roof is properly thatched, and then secured from receiving any damage from the wind, by means of a straw rope, extended along the eves, up the ends, and near the ridge. The ends of the thatch are afterwards cut evenly below the eves of the stack, just of sufficient length for the rain-water to drip quite clear of the hay. When the stack happens to be placed in a situation which may be suspected of being too damp in the winter, a trench, of

about six or eight inches deep, is dug round, and nearly close to it, which serves to convey all the water from the spot, and renders it perfectly dry and secure.

ESSAY XVI.

On the effects of Country Banks on the price of Provisions.

IN all countries of trade, and in every well regulated government, monopolies have either not been permitted, or if any have taken place, they have speedily been destroyed. Now, if monopolies have done harm in every other article of trade, they are surely more likely to prove hurtful when applied to money, by which alone trade of every kind is carried on.

In the first place, it would do an important injury to the nation, by leſsening the security of the whole of its paper currency. By confining the privilege of iſsuing bank notes to a

single company or two, the nation would have no other security for all the notes that they might iſsue, but the private fortunes of the few partners of which these companies might consist: whereas, by giving free permiſsion to country banks, a large proportion of the whole wealth of the kingdom is pledged for their security, as undoubtedly is the case at present.

If, on the contrary, all the bank notes in the kingdom were iſsued by one, two, or three banks, as much of the national buſineſs is now carried on by notes, the sums which they would give out or circulate would neceſsarily be immenſe, in proportion to their capitals; and still more extensive, in proportion to the quantity of gold and silver which they could retain to give in exchange for their notes. The consequence of which would be, that they would much more frequently meet with difficulties, and be obliged to avoid payments in money, as very recently has been the case even with the national bank of Britain, than there is reason to think would at any period happen, if every city and district in the kingdom were permitted to establish its own banks. Small banks, from having

no dependence on the influence of large capitals, nor any adventitious support, but trusting entirely to the punctuality with which their business is done, for the credit that they enjoy, and finding it much for their interest never to extend their transactions beyond what their funds can bear, will very seldom be found to have done so; and if occasionally a bank of this kind should transgress, it could never be in any considerable degree. The loss would, therefore, be of little importance, and confined to a small district, instead of extending over the whole kingdom, and carrying ruin along with it to the whole of our manufactures, as certainly would be the case, if a failure should ever occur of a national bank, endowed with the exclusive privilege of supplying the kingdom with bank notes.

If the paper-dollars of North America had been issued by opulent individuals in every district of the United States; and if this also had been done with the assignats of France; neither the paper currency of America or France would ever have been depreciated; for in that case almost the whole of the territory of both countries would have been responsible for the amount of it: but this not

being done, for the coinage of paper both in America and France was exclusively managed by a single company, that is, by the government, it soon fell into discredit; and was so much depreciated at last, that it literally became of leſs value than blank paper.

Let none, therefore, who wish to give stability to the paper currency of Britain, ever desire to suppreſs, restrict, or regulate our country banks; which could not in any degree be done, without increasing the circulation of the notes of some other bank in the same proportion; by which our security for the payment of these notes would neceſsarily in the same degree be diminished.

At present no inconvenience might ensue from this, as there is reason to hope that the wealth of our national bank is equal to all the notes which it may poſsibly iſsue. But, if this, or other banks, from being poſseſsed of the exclusive privilege of supplying the nation with notes, should be tempted to iſsue more than the amount of their capitals, which very probably would happen; and if either from fear, or from any other cause, their credit should become doubtful; the whole of their

notes in circulation might fall in the space of a few days to a very small proportion of their original value, and thus would end in the ruin of a large proportion of the community.

This, again, can very seldom happen with country banks, few of which can ever get credit for a larger circulation of their notes than the fortunes of those individuals by whom they are iſsued would be able to pay; at the same time, that the whole fortune of every person concerned in these banks, is answerable for their notes, which is seldom or never the case with banks erected by governments.

It might easily be proved, that, in a material degree, country banks prove useful to agriculture, and thereby tend to leſsen rather than to raise the prices of produce. Were it even the case that they enable farmers to withhold their produce from some markets, and in a much greater degree than they have ever probably done, with the view of obtaining higher prices in others; as it would only happen when prices are low, instead of this doing harm, it might be easily shown that much benefit would arise from it, as it would leſsen the consumption, when provisions are abun-

dant, as commonly is the case immediately after harvest, and in the same proportion would reduce the prices in the advanced seasons of spring and summer, when they generally become scarce, and consequently dear.

But, independently of this, country banks prove useful to agriculture, and thereby to the public, by enabling farmers to carry on improvements with more expedition and certainty, than otherwise they could do. Were it not for the accommodation that farmers receive from bankers, improvements of the most important kind would frequently stop, and might never be entered upon again. In this view, farmers are precisely in the same situation with manufacturers and merchants. All of them apply to banks for money, when they do not find purchasers for the articles in which they deal; and why should not farmers receive the same accommodation with others? Bankers will give their notes to none of them if they are not satisfied with their security; but it surely would be reckoned very unjust and oppreſsive, if on this security being given by farmers, they should not be entitled to the same accommodation which, in all similar circumstances, is given to others. They would

not only consider it as a disgrace, and hence would desert their profeſsion, but, in reality, it would be the cause of much pecuniary loſs to all of them.

Those who imagine that the opulent state of farmers and country banks are the chief causes of dearth, do not consider that the two are incompatible with each other. Banks must prove chiefly useful to poor farmers: for those who are opulent can act as their own bankers; and while the entire suppreſsion of banks could not so materially affect them, it could scarcely fail to ruin all who hitherto have found it neceſsary to trust to them.

By that kind of accommodation which farmers receive from banks, they have been enabled, for many years past, to improve and retain in tillage a much larger quantity of land than otherwise they could have done: not probably leſs than an eighth part of the whole lands in the kingdom that are now in cultivation; but were it only a tenth part, or even no more than a twentieth, still more produce of corn would be obtained from it than can ever be derived from importing it, with this important difference, that in the one

way we procure it without sending money out of the kingdom, while, at the same time, we render our own property much more valuable: whereas, by the other, we are expending twelve millions yearly in the improvement of other countries, and at the same time are giving high premiums, nearly to the amount of three millions, for bringing the produce of these very improvements to Britain; a conduct for which the people in those countries to which we apply for corn, can only be able to account, by supposing that the whole of our own property is so fully cultivated, that it cannot be made better.

Now, if this be the true state of the case, that farmers are enabled to improve the lands which they poſsefs, and thereby to bring a larger quantity of produce to sale, in consequence of that accommodation which they receive from banks; a fact that few will dispute, it must of neceſsity follow, that nearly in proportion to the amount of this accommodation, country banks will be found to reduce rather than to increase the price of provisions; for, as I have already had occasion to say, if provisions be produced, they must be quickly sold; for neither animal food nor corn can

ever be long kept but with much loſs; so that if by the influence of country banks, or any other cause, these articles are brought in larger quantities to market than otherwise would be the case, the prices in the same proportion must be low.

ESSAY XVII.

On Live Stock.

IN a country like this, where animal food forms so considerable a part of the sustenance of its inhabitants, and where horses are of so much consequence in every department of buſineſs, no subject can well be of more general importance, or more worthy of attention, than that of live stock.

Before I proceed more minutely to discuſs this important branch of the rural art, I would premise a few observations, namely, that who-

ever means to attempt any considerable improvement of his live stock, should, first of all, be sure to have a proper degree of shelter, shade, and warmth; and in the next place, if his land be not already of the richest quality, he should set about bringing it to that degree of perfection; at least, he must drain it completely, and, if poſsible, make water-meadows, raising the whole to the highest degree of cultivation of which it is capable; as the live stock will, in some measure, keep pace with the improved state of the land.

Both reason and experience prove, that vegetables and animals are, in some degree, proportioned to the quality of the land on which they are grown, or reared.

Rich land naturally produces a luxuriant herbage, and such rich food will certainly raise large animals: on the contrary, dwarf plants are generally met with on a poor soil, and the poverty of such food as certainly produces stunted animals. To prove this, let any one disposed to try the experiment, take twin lambs at the birth; let him rear one in the poorest manner, and the other in the richest; he will then find that the latter has

grown to two or three times the weight of the former in the same space of time.

One of the certain consequences resulting from a general inclosure, and improved husbandry, would be a more plentiful supply of nutritious diet for all kinds of animal stock; and the size of the various breeds of cattle and sheep, would certainly increase proportionably to the quantity and quality of their vegetables on which they feed. A more powerful argument in favour of a general inclosure cannot perhaps by found

With respect to the choice of stock, at least, in regard to size, the farmer should keep in view the nature and quality of the soil; as live stock of every kind, and of all the various breeds, should, in point of size, be proportioned to the quantity and quality of their intended food. The richest grazing land, and the most nourishing artificial food, will certainly pay more in feeding large bullocks, sheep, and swine, than it would do in feeding the smaller sizes of the same species; and it is equally obvious, that the smaller breeds will answer better on poor pasture than the larger.

The preference to be given to any particular breed, of every species of live stock, should be determined by the principal object the breeder has in view. If it be to poſſeſs a stock that is disposed to become more early fat with a smaller quantity of food, than another breed, the chief thing to be done to attain this object, will be, to procure a male and female poſſeſsing such quality in a higher degree of perfection than others of their species. Their offspring will certainly poſſeſs the quality of their parents, and should not by any means be croſsed with any other breed but such as have the said qualities, if not in a superior, at least in an equal degree with themselves. And it is worthy of attention, that a wild or unsettled disposition in any animal, is a certain drawback on its powers of feeding; as, on the other hand, a quiet, easy-tempered, docile nature, predisposes such animal to the accumulation of fat.

If quantity of milk be the object to be attained, such a cow as is mentioned in the Lancashire Report, page 151, should by all means be procured. This cow gave twenty-two quarts of milkdaily, and her milk, in one

week, yielded eighteen pounds of butter. Neither labour nor expense should be spared to discover the bull from whom she sprung, for they would together be worth almost any money. By invariably breeding in the same family, or blood, a great acquisition would be made, as all their offspring would undoubtedly partake of the qualities for which their parents are estimable. After having once procured the best milkers, it would be absurd to admit a croſs from any other breed, unleſs they should have the same perfections in at least an equal degree; as croſsing the breed with one that gives leſs milk than your own, must inevitably defeat the intended object.

The same observations apply with equal force to every other species of live stock.

ESSAY XVIII.

On the Fecundation of Vegetables.

THE breeders of animals have very long entertained an opinion, that considerable advantages are obtained by breeding from males and females not related to each other. Though this opinion has lately been controverted, the number of its opposers has gradually diminished; and I can speak from my own observation and experience, that animals degenerate, in the size at least, on the same pasture, and in other respects under the same management, when this procefs of crofsing the breed is neglected.

The close analogy between the animal and vegetable world, and the sexual system equally pervading both, induced me to suppose, that similar means might be productive of similar effects in each; and the event has, I think, fully justified this opinion. The principal object I had in view, was to obtain new and improved varieties of the apple, to supply the

place of those which have become diseased and unproductive, by having been cultivated beyond the period which nature appears to have assigned to their existence. But, as I foresaw that several years must elapse, before the success or failure of this process could possibly be ascertained, I wished, in the interval, to see what would be its effects on annual plants. Amongst these, none appeared so well calculated to answer my purpose as the common pea; not only because I could obtain many varieties of this plant, of different forms, sizes, and colours; but also, because the structure of its blossom, by preventing the ingress of insects and adventitious farina, has rendered its varieties remarkably permanent. I had a kind growing in my garden, which, having been long cultivated in the same soil, had ceased to be productive, and did not appear to recover the whole of its former vigour, when removed to a soil of a somewhat different quality; on this, my first experiment, in 1787, was made. Having opened a dozen of its immature blossoms, I destroyed the male parts, taking great care not to injure the female ones; and, a few days afterwards, when the blossoms appeared mature, I introduced the farina of a very large and luxuriant grey

pea into one half of the bloſsoms, leaving the other half as they were. The pods of each grew equally well; but I soon perceived, that in those, into whose bloſsoms the farina had not been introduced, the seeds remained nearly as they were before the bloſsoms expanded, and in that state they withered. Those in the other pods attained maturity, but were not in any sensible degree different from those afforded by other plants of the same variety; owing, I imagine, to the external covering of the seed (as I have found in other plants) being furnished entirely by the female. In the succeeding spring, the difference, however, became extremely obvious; for the plants from them rose with exceſsive luxuriance, and the colour of their leaves and stems clearly indicated, that they had all exchanged their whiteneſs for the colour of the male parent: the seeds produced in autumn were dark grey. By introducing the farina of another white variety, (or, in some instances, by simple culture,) I found this colour was easily discharged, and a numerous variety of new kinds produced, many of which were, in size, and in every other respect, much superior to the original white kind, and grew with exceſsive luxuriance, some of them attaining

the height of more than twelve feet. I had frequent occasion to observe, in this plant, a stronger tendency to produce purple blosoms; and coloured seeds, than white ones; for, when I introduced the farina of a purple blosom into a white one, the whole of the seeds in the succeeding year became coloured; but, when I endeavoured to discharge this colour, by reversing the proceſs, a part only of them afforded plants with white blosoms; this part sometimes occupying one end of the pod, and being at other times irregularly intermixed with those which, when sown, retained their colour. It may perhaps be supposed, that something might depend on the quantity of farina employed; but I never could discover, in this, or in any other experiment, in which superfœtation did not take place, that the largest or smallest quantity of farina afforded any difference in the effect produced.

The diſsimilarity I observed in the offspring afforded by different kinds of farina, in these experiments, pointed out to me an easy method of ascertaining whether superfœtation (the existence of which has been admitted amongst animals) could also take place in the vegetable

world. For, as the offspring of a white pea is always white, unleſs the farina of a coloured kind be introduced into the bloſsom, and, as the colour of the grey one is always transferred to its offspring, though the female be white, it readily occurred to me, that if the farina of both were mingled, or applied at the same moment, the offspring of each could be easily distinguished.

My first experiment was not altogether succeſsful; for the offspring of five pods (the whole which escaped the birds) received their colour from the coloured male. There was however, a strong resemblance to the other male, in the growth and character of more than one of the plants; and the seeds of several, in the autumn, very closely resembled it in every thing but colour. In this experiment, I used the farina of a white pea, which poſseſsed the remarkable property of shrivelling exceſsively when ripe; and, in the second year, I obtained white seeds, from the grey ones above-mentioned, perfectly similar to it. I am strongly disposed to believe, that the seeds were here of common parentage; but I do not conceive myself to be in poſseſsion of

facts sufficient to enable me to speak with decision on this question.

If, however, the female afford the first organized atom, and the farina act only as a stimulus, it appears to me by no means impoſsible, that the explosion of two vesicles of farina, at the same moment, (taken from different plants,) may afford seeds (as I have supposed) of common parentage; and, as I am unable to discover any source of inaccuracy in this experiment, I must believe this to have happened.

Another species of superfœtation (if I have justly applied that term to a proceſs in which one seed appears to have been the offspring of two males) has occurred to me so often, as to remove all poſsibility of doubt as to its existence. In 1797, the year after I had seen the result of the last mentioned experiment, having prepared a great many white bloſsoms, I introduced the farina of a white and that of a grey pea, nearly at the same moment, into each; and as, in the last year, the character of the coloured male had prevailed, I used its farina more sparingly than that of the white

one; and now almost every pod afforded plants of different colours. The majority, however, were white; but the characters of the two kinds were not sufficiently distinct to allow me to judge with precision, whether any of the seeds produced were of common parentage or not. In the last year, I was more fortunate: having prepared blossoms of the little early frame pea, I introduced its own farina, and immediately afterwards that of a very large and late grey kind, and I sowed the seeds thus obtained in the end of the last summer. Many of them retained the colour and character of the small early pea, not in the slightest degree altered, and blossomed before they were eighteen inches high; whilst others, (taken from the same pods,) whose colour was changed, grew to the height of more than four feet, and were killed by the frost before any blossoms appeared.

It is evident, that in these instances superfœtation took place; and it is equally evident, that the seeds were not all of common parentage. Should subsequent experience evince, that a single plant may be the offspring of two males, the analogy between animal and vegetable nature may induce some curious con-

jecture, relative to the proceſs of generation in the animal world.

In the course of the preceding experiments, I could never observe that the character, either of the male or female, in this plant, at all preponderated in the offspring; but, as this point appeared interesting, I made a few trials to ascertain it. And, as the foregoing observations had occurred in experiments made principally to obtain new and improved varieties of the pea, for garden culture, I chose, for a similar purpose, the more hardy varieties usually sown in the fields. By introducing the farina of the largest and most luxuriant kinds into the bloſsoms of the most diminutive, and by reversing this proceſs, I found that the powers of the male and female, in their effects on the offspring, are exactly equal. The vigour of the growth, the size of the seeds produced, and the season of maturity, were the same, though the one was a very early, and the other a late variety. I had in this experiment, a striking instance of the stimulative effects of croſsing the breeds; for the smallest variety, whose height rarely exceeded two feet, was increased to six feet; whilst the height of the large and luxuriant kind was

very little diminished. By this proceſs, it is evident, that any number of new varieties may be obtained; and it is highly probable, that many of these will be found better calculated to correct the defects of different soils and situations, than any we have at present; for, I imagine that all we now poſseſs, have in a great measure been the produce of accident; and it will rarely happen, in this or any other case, that accident has done all that art will be found able to accomplish.

The succeſs of my endeavours to produce improved varieties of the pea, induced me to try some experiments on wheat; but these did not succeed to my expectations. I readily obtained as many varieties as I wished, by merely sowing the different kinds together; for the structure of the bloſsom of this plant (unlike that of the pea) freely admits the ingreſs of adventitious farina, and is thence very liable to sport in varieties. Some of those I obtained were excellent; others very bad; and none of them permanent. By separating the best varieties, a most abundant crop was produced; but its quality was not quite equal to the quantity, and all the discarded varieties again made their appearance. It appeared to me an extraordinary circumstance, that, in the years

1795 and 1796, when almost the whole crop of corn in the island was blighted, the varieties thus obtained, and these only, escaped, in this neighbourhood, though sown in several different soils and situations.

My succeſs on the apple (as far as long experience and attention have enabled me to judge from the cultivated appearance of trees which have not yet borne fruit) has been fully equal to my hopes. But as the improvement of this fruit was the first object of my attention, no probable means of improvement, either from soil or aspect, were neglected. The plants, however, which I obtained from my efforts to unite the good qualities of two kinds of apple, seem to poſseſs the greatest health and luxuriance of growth, as well as the most promising appearance in other respects. In some of these, the character of the male appears to prevail; in others, that of the female; and in others, both appear blended, or neither is distinguishable. These variations, which were often observable in the seeds taken from a single apple, evidently arise from the want of permanence in the character of this fruit, when raised from seed.

The results of similar experiments on another fruit, the grape, were nearly the same as of those on the apple, except that by mingling the farina of a black and white grape, just as the blossoms of the latter were expanding, I sometimes obtained plants, from the same berry, so dissimilar, that I had good reason to believe them the produce of superfœtation. By taking off the cups, and destroying the immature male parts, (as in the pea) I perfectly succeeded in combining the characters of different varieties of this fruit, as far as the changes of form, and autumnal tints, in the leaves of the offspring, will allow me to judge.

Many experiments, of the same kind, were tried on other plants; but it is sufficient to say, that all tended to evince, that improved varieties of every fruit and esculent plant may be obtained by this process, and that nature intended that a sexual intercourse should take place between neighbouring plants of the same species. The probability of this will, I think, be apparent, when we take a view of the variety of methods which nature has taken to disperse the farina, even of those plants in which it has placed the male and female parts within the same empale-

ment. It is often scattered by an elastic exertion of the filaments which support it, on the first opening of the bloſsom; and its exceſsive lightneſs renders it capable of being carried to a great distance by the wind. Its position within the bloſsom is generally well adapted to place it on the bodies of insects; and the villous coat of the numerous family of bees, is not leſs well calculated to carry it. I have frequently observed, with great pleasure, the dispersion of the farina of some of the graſses, when the sun had just risen in a dewy morning. It seemed to be impelled from the plant with considerable force; and, being blue, was easily visible, and very strongly resembled, in appearance, the explosion of a grain of gunpowder. An examination of the structure of the bloſsoms of many plants, will immediately point out, that nature has something more in view, than that its own proper males should fecundate each bloſsom; for the means it employs are always those best calculated to answer the intended purpose. But the farina is often so placed, that it can never reach the summit of the pointal, unleſs by adventitious means; and many trials have convinced me, that it has no action on any other part of it. In promoting

this sexual intercourse between neighbouring plants of the same species, nature appears to me to have an important purpose in view; for, independent of its stimulative power, this intercourse certainly tends to confine within more narrow limits, those variations which accidental richneſs or poverty of soil usually produces. It may be objected, by those who admit the existence of vegetable mules, that, under this extensive intercourse, these must have been more numerous; but my total want of succeſs, in many endeavours, to produce a single mule plant, makes me much disposed to believe that hybrid plants have been mistaken for mules; and to doubt (with all the deference I feel for the opinions of LINNÆUS and his illustrious followers) whether nature ever did, or ever will, permit the production of such a monster. The existence of numerous mules in the animal world, between kindred species, is allowed; but nature has here guarded against their production, by impelling every animal to seek its proper mate; and, amongst the feathered tribe, when, from perversion of appetite, sexual intercourse takes place between those of distinct genera*, it

* This is said to be the case with the drake and the hen.

has, in some instances at least, rendered the death of the female the inevitable consequence. But, in the vegetable world, there is not any thing to direct the male to its proper female: its farina is carried by winds and insects, to plants of every different genus and species; and it therefore appears to me, (as vegetable mules certainly are not common), that nature has not permitted them to exist at all.

I cannot dismiss this subject, without expressing my regret, that those who have made the science of botany their study, should have considered the improvement of those vegetables which, in their cultivated state, afford the largest portion of subsistence to mankind and other animals, as little connected with the object of their pursuit. Hence it has happened, that whilst much attention has been paid to the improvement of every species of useful animal, the most valuable esculent plants have been almost wholly neglected. But, when the extent of the benefit which would arise to the agriculture of the country, from the possession of varieties of plants which, with the same extent of soil and labour, would afford even a small increase of produce, is considered, this subject appears of no in-

considerable importance. The improvement of animals is attended with much expense, and the improved kinds neceſsarily extend themselves slowly; but a single bushel of improved wheat or peas, may in ten years be made to afford seed enough to supply the whole island; and a single apple, or other fruit-tree, may within the same time be extended to every garden in it.

ESSAY XIX.

On Prospective Contrivances.

I CAN hardly imagine to myself a more distinguishing mark, and, consequently, a more certain proof of design, than *preparation*, i. e. the providing of things before hand, which are not to be used until a considerable time afterwards; for this implies a contemplation of the future, which belongs only to intelligence.

Of these prospective contrivances the bodies of animals furnish various examples.

I. The human teeth afford an instance, not only of prospective contrivance, but of the completion of the contrivance being designedly suspended. They are formed within the gums, and there they stop: the fact being, that their further advance to maturity would not only be useleſs to the new-born animal, but extremely in its way; as it is evident that the act of *sucking*, by which it is for some time to be nourished, will be performed with more ease both to the nurse and to the infant, whilst the inside of the mouth, and edges of the gums, are smooth and soft, than if set with hard pointed bones. By the time they are wanted, the teeth are ready. They have been lodged within the gums for some months past, but detained, as it were, in their sockets, so long as their further protrusion would interfere with the office to which the mouth is destined. Nature, namely, that intelligence which was employed in creation, looked beyond the first year of the infant's life; yet, whilst she was providing for functions which were after that term to become neceſsary, was careful not to incommode those which

preceded them. What renders it more probable that this is the effect of design is, that the teeth are imperfect, whilst all other parts of the mouth are perfect. The lips are perfect, the tongue is perfect; the cheeks, the jaws, the palate, the pharynx, the larynx, are all perfect. The teeth alone are not so. This is the fact with respect to the human mouth: the fact also is, that the parts above enumerated, are called into use from the beginning; whereas the teeth would be only so many obstacles and annoyances, if they were there. When a contrary order is necefsary, a contrary order prevails. In the worm of the beetle, as hatched from the egg, the teeth are the first things which arrive at perfection. The insect begins to gnaw as soon as it escapes from the shell, though its other parts be only gradually advancing to their maturity.

What has been observed of the teeth, is true of the *horns* of animals; and for the same reason. The horn of a calf or lamb does not bud, or at least does not sprout to any considerable length, until the animal be capable of browsing upon its pasture; because such a substance upon the forehead of the young animal, would very much incom-

mode the teat of the dam in the office of giving suck.

But in the case of the *teeth*, of the human teeth at least, the prospective contrivance looks still further. A succeſsion of crops is provided, and provided from the beginning; a second tier being originally formed beneath the first, which do not come into use till several years afterwards. And this double or suppletary provision meets a difficulty in the mechanism of the mouth, which would have appeared almost unsurmountable. The expansion of the jaw, (the consequence of the proportionable growth of the animal, and of its skull,) neceſsarily separates the teeth of the first set, however compactly disposed, to a distance from one another, which would be very inconvenient. In due time therefore, i. e. when the jaw has attained a great part of its dimensions, a new set of teeth springs up, (loosening and pushing out the old ones before them), more exactly fitted to the space which they are to occupy, and rising also in such close ranks, as to allow for any extension of line which the subsequent enlargement of the head may occasion.

II. It is not very easy to conceive a more evidently prospective contrivance, than that which, in all viviparous animals, is found in the *milk* of the female parent. At the moment the young animal enters the world, there is its maintenance ready for it. The particulars to be remarked in this œconomy are neither few nor slight. We have, first, the nutritious quality of the fluid, unlike, in this respect, every other excretion of the body; and in which nature hitherto remains unimitated, neither cookery nor chymistry having been able to make milk out of grafs: we have, secondly, that organ for its reception and retention. we have, thirdly, the excretory duct, annexed to it: and we have, lastly, the determination of the milk to the breast, at the particular juncture when it is about to be wanted. We have all these properties in the subject before us; and they are all indications of design. The last circumstance is the strongest of any. If I had been to gueſs before-hand, I should have conjectured, that, at the time when there was an extraordinary demand for nourishment in one part of the system, there would be the least likelihood of a redundancy to supply another part. The advanced pregnancy of the female has no in-

telligible tendency to fill the breasts with milk. The lacteal system is a constant wonder; and it adds to other causes of our admiration, that the number of the teats or paps in each species is found to bear a proportion to the number of the young. In the sow, the bitch, the rabbit, the cat, the rat, which have numerous litters, the paps are numerous and are disposed along the whole length of the belly: in the cow and mare they are few. The most simple account of this, is to refer it to a designing Creator.

In the argument before us, we are entitled to consider not only animal bodies when framed, but the circumstances under which they are framed. And, in this view of the subject, the constitution of many of their parts, is, most strictly, prospective.

III. The eye is of no use, at the time when it is formed. It is an optical instrument made in a dungeon; constructed for the refraction of light to a focus, and perfect for its purpose, before a ray of light has had access to it; geometrically adapted to the properties and action of an element, with which it has no communication. It is about indeed to enter

into that communication; and this is precisely the thing which evidences intention. It is providing for the future in the closest sense which can be given to these terms; for it is providing for a future change: not for the then subsisting condition of the animal; not for any gradual progress or advance in that same condition; but for a new state, the consequence of a great and sudden alteration, which the animal is to undergo at its birth. Is it to be believed that the eye was formed, or, which is the same thing, that the series of causes was fixed by which the eye is formed, without a view to this change; without a prospect of that condition, in which its fabric, of no use at present, is about to be of the greatest; without a consideration of the qualities of that element, hitherto entirely excluded, but with which it was hereafter to hold so intimate a relation? A young man makes a pair of spectacles for himself against he grows old; for which spectacles he has no want or use whatever at the time he makes them. Could this be done without knowing and considering the defect of vision to which advanced age is subject? Would not the precise suitableness of the instrument to its purpose, of the remedy to the defect, of the

convex lens to the flattened eye, establish the certainty of the conclusion, that the case, afterwards to arise, had been considered beforehand, speculated upon, provided for? all which are exclusively the acts of a reasoning mind. The eye formed in one state, for use only in another state, and in a different state, affords a proof no less clear of destination to a future purpose; and a proof proportionably stronger, as the machinery is more complicated, and the adaptation more exact.

IV. What has been said of the eye, holds equally true of the lungs. Composed of air-vessels, where there is no air; elaborately constructed for the alternate admission and expulsion of an elastic fluid, where no such fluid exists; this great organ, with the whole apparatus belonging to it, lies collapsed in the fœtal thorax, yet in order, and in readiness for action, the first moment that the occasion requires its service. This is having a machine locked up in store for future use; which incontestibly proves, that the case was expected to occur, in which this use might be experienced; but expectation is the proper act of intelligence. Considering the state in

which an animal exists before its birth, I should look for nothing less in its body than a system of lungs. It is like finding a pair of bellows in the bottom of the sea; of no sort of use in the situation in which they are found; formed for an action which was impossible to be exerted; holding no relation or fitness to the element which surrounds them, but both to another element in another place.

As part and parcel of the same plan, ought to be mentioned, in speaking of the lungs, the provisionary contrivances of the foramen ovale and ductus arteriosus. In the fœtus, pipes are laid for the passage of the blood through the lungs; but, until the lungs be inflated by the inspiration of air, that passage is impervious, or in a great degree obstructed. What then is to be done? What would an artist, what would a master, do upon the occasion? He would endeavour, most probably, to provide a temporary passage, which might carry on the communication required, until the other was open. Now this is the thing, which is actually done in the heart. Instead of the circuitous route through the lungs, which the blood after-

wards takes, before it gets from one auricle of the heart to the other; a portion of the blood paſses immediately from the right auricle to the left, through a hole, placed in the partition which separates these cavities. This hole anatomists call the *foramen ovale*. There is likewise another croſs cut, answering the same purpose, by what is called the *ductus arteriosus*, lying between the pulmonary artery and the aorta. But both expedients are so strictly temporary, that, after birth, the one paſsage is closed, and the tube which forms the other, shrivelled up into a ligament. If this be not contrivance, what is?

But, forasmuch as the action of the air upon the blood in the lungs, appears to be neceſsary to the perfect concoction of that fluid, i. e. to the life and health of the animal, (otherwise the shortest route might still be the best,) how comes it to paſs that the *fœtus* lives, and grows, and thrives without it? The answer is, that the blood of the fœtus is the mother's; that it has undergone that action in her habit; that one pair of lungs serves for both. When the animals are separated, a new neceſsity arises; and to meet this neceſsity as soon as it occurs,

an organization is prepared. It is ready for its purpose: it only waits for the atmosphere: it begins to play, the moment the air is admitted to it.

ESSAY XX.

The Economy of a Dutch Dairy.

THE economy of the Dutch, in the management of their milch cows, being an object worthy of inquiry, I here offer such information on the subject, as my cursory notes, made some years since on the spot, furnish me with, on the inspection of three great cow-houses at Utrecht, Harlaem, and Amsterdam; which were constructed on an oblong square, and of a moderate height, with a slight floor over head, for a certain occasional quantity of hay cut out of a Dutch barn adjoining the cow-house. The building within was airy and luminous; its length determined by the

number of the cows, which might amount from forty to sixty, or more, and from three to four feet allowed to each cow—its breadth from thirty to forty feet, which may thus be distributed: twelve feet in the centre, between two rows of cows, including a sloping gutter on either side, in the front of, and in a line with, the heads of the cows; five feet on either side for their standing, and immediately behind their tails a gutter two feet wide, and nearly as many deep, and also a four feet walk on either side, behind each gutter. The centre walk is paved with clinkers, and kept very clean, and sanded, between which and the two sloping channels, paved likewise with clinkers, (one in each front row of the cows,) is a thick board, a foot and a half high, fixed edgeways, to keep the hay, &c. on which the cows are fed, within the bounds of the channel. The cows are tied up with a slight chain, or rope round the neck, fastened to an iron ring, running up and down a fixed post; under the standing of the fore and hind feet of the cows, fir timber, a foot and half wide, is extended the whole length of the houſe (as stone, or any harder substance, would probably founder their feet) and the interval filled up with a floor of sand and lime, gradually

depreſsed towards the middle, the better to receive the incumbent belly of the cow. The timber, on which the hind feet stand, is rather higher than that in front, both to enable the cow to reach her meat the more easily, and likewise to eject her excrements the more cleanly. Each cow's tail is platted, and, to promote cleanlineſs, tied by a slight cord fastened to a narrow slip of deal, nailed above, which prevents their flourishing their tails, but not their lying down.

Their food is hay, with repeated warm meſses of grains, boiled turnips, potatoes, cabbage, refuse carrots, oil-cake, buck-wheat, &c. &c. which are placed before them in the front channel above-mentioned, at the upper end of which is fixed a pump to supply them with water, which they drink, as it glides gently down before them in the said channel; and in very cold weather, the pump water is tempered with hot water. In order to remove the excrements in the gutter before-mentioned, a square board, fixed in a long handle, the exact breadth of the clinker-paved gutter, is used, with which they are pushed down the gutter, and through an opening at the extremity of the house, into a deep pit made to

receive them; and afterwards, by means of a long spout, water is conveyed from the pump into the gutter, which is washed perfectly clean, twice, or oftener, in the day; as also is the channel in front of the cows. As the cows remain constantly tied up, from the time they return from pasture to their winter quarters, in November or December, according to the season of the year, till they go to grafs in April, it is surprising, from this arrangement and economy, with what facility and thrift a great number of cows are taken care of by very few hands; and also with what neatnefs, though they are allowed no litter, but what little refuse hay is left by them. The eye of the master indeed is always upon them; for at the upper end of their house he also has usually his abode, divided only by a running curtain, but fitted up with every convenience, and in the neatest manner, for conducting the dairy, as coppers for boiling water, and the various mefses for the cows, &c. In short, no people on earth (the Chinese not excepted) study and practice the "*multum in parvo*" more aſsiduously, and with greater succefs, than the patient, industrious, frugal, provident Dutchman, among whom many ingenious contrivances in all arts and profefsions

are to be found, worthy the imitation of the most enlightened nations. When the cows go to graſs, they are clothed, (at least those which are tender, or have lately calved) with a coarse hempen jacket extending from the shoulders to the rump, and half way down the ribs, and fastened by strings under the legs; the intention of which is to guard those which are tender, &c. after their winter's confinement, from the perpendicular dews, which are very heavy in their low, deep rich meadows, and likewise to increase their milk, which warmth very eſsentially contributes to do. The same precaution is adopted, I understand, in winter, before they return to house, if the weather is severe, or when a cow calves late. While at graſs, their keepers avail themselves of every opportunity to supply them with brewers wash, &c. which from habit they drink greedily, in preference to such unpalatable (if not brackish) water as their dykes usually afford.

After the cows quit their winter quarters, their house is cleaned with the greatest niceneſs, and even the boards washed, and scoured with hot water, sand, and soap; but notwithstanding all this neatneſs, and the con-

stant care and attention of their owners, it sometimes happens, as in 1772 and 1773, that they lose the greater part of their stock: the bowels were generally first attacked, and, that so violently as to prove fatal in a few hours. This distemper then prevailed not only in the cow-houses, but pursued the poor animals to their pastures, in one of which half the herd would be swept off in a few days, and all escape perhaps in that adjoining; while in a third neighbouring pasture the distemper raged with equal violence as in the first. No leſs various was the conduct of the several proprietors on this occasion—some considered the distemper as a judgment from heaven, and thought it in vain, if not impious, to attempt any means for their recovery. Others, leſs superstitious, adopted the most celebrated remedies, and left no means unessayed to oppose the virulence of the distemper, but with little succeſs. It is remarkable, that the cows in Flanders are generally very healthy, notwithstanding they lie on their dung, more or leſs, the year round. The Flemish peasant keeps his cattle rather in a cave, than a cow-house, and instead of carrying out the dung, fresh litter, and dry sand, or earth, is added daily to it, so that before this

cave, or cow-house, is cleaned out, the cattle stand six feet, or more, higher than the floor. His milch cows (as well as horses) are housed every night, even in the summer, and are fed with trefoil, or clover, or vetches, &c. and let out to feed in the pastures early in the morning, and brought back to house about ten; have trefoil, &c. till four in the afternoon, and are then turned out till eight; by which means an immense quantity of the richest manure is raised in Flanders during the whole summer, which, by cattle being kept in the fields in that season in all other countries, becomes the food of flies, and the sport of winds. Fatting bullocks alone are permitted to lie abroad day and night in Flanders, otherwise they would not fat in very hot weather. In winter, the Flemings feed their cows with hot meſses, &c. nearly as the Dutch do.

ESSAY XXI.

On the Renovation of old Pear-trees.

FINDING the pear-trees in Kensington Gardens in a very cankery and unfruitful state, in the years 1784 and 1785, I took out the old mould from the borders against the walls, and put in fresh loam in its stead; at the same time I pruned and nailed the trees in the common way, and left them in that state upwards of eighteen months, to see what effect the fresh mould would have on them; but, to my great surprise, I found that it had no good effect.

After I had tried the fresh mould as above, I began to consider what was best to be done with so many old pear-trees that were worn out. The fruit that they produced I could not send to his Majesty's table with any credit to myself, it being small, hard, and kernelly. I thought it would be a great reflection on me, as a profefsional man, that after I had put his Majesty to so great an ex-

pense, no advantage was likely to be derived from it. I saw that some method must be tried to restore these old trees, or that next year they must be grubbed up, and was loath to give them entirely up before I had tried some experiments. I considered that it must be between twelve and fourteen years before I could have any fruit from young trees; and therefore determined to try an experiment, with a view to recovering the old ones.

I began with cutting down four old and decayed pear-trees of different kinds, near to the place where they had been grafted: this operation was performed on the 15th of May 1786. Finding that they put forth fine shoots, I headed down four more on the 20th of June, in the same year (for by this time, the former had shoots of a foot long), which did equally well, and bore some fruit in the following year. One of the first four that I headed down was a St. Germain, which produced nineteen fine, large, well-flavoured pears next year, and in the third bore more fruit than it did in its former state when it was four times the size.

I left seven trees upon an east wall, treated

according to the common method of pruning, which bore the following number of pears upon each tree.

Epine d'hiver produced eighty-six pears, and the tree spread fifteen yards.

A *crasane* produced one hundred pears, and the tree spread fourteen yards.

Another *crasane* produced sixteen pears, and the tree spread ten yards.

A *virgouleuse* produced one hundred and fifty pears, and the tree spread nine yards.

A *colmar* produced one hundred and fifty pears, and the tree spread nine yards.

Another *colmar* produced seventy-nine pears, and the tree spread ten yards.

A *l'eschasserie* produced sixty pears.

Seven trees headed down and pruned according to my method, leaving the fore-right shoots in summer, bore as follows, in the fourth year after heading.

A *louisbonne* bore four hundred and sixty-three pears, and the tree spread nine yards.

Another *louisbonne* bore three hundred and ninety-one pears, and spread eight yards.

A *colmar* bore two hundred and thirteen pears, and spread six yards.

A *brown beurré* bore five hundred and three pears.

Another *brown beurré* bore five hundred and fifty pears.

A *crasane* bore five hundred and twenty pears.

A *virgouleuse* bore five hundred and eighty pears.

The branches of the four last trees spread nearly in the same proportion as the first three.

A young *beurré*, the second year after heading, bore two hundred and thirty pears; and a St. Germain four hundred.

All the above trees stood upon the same aspect and the same wall, and the fruit was numbered in the same year. A great many pears which dropped from the trees are not reckoned. The trees that were pruned according to the old practice, covered at least one-third more wall than the others.

By the above statement, it appears, that the trees headed down, bore upwards of five times the quantity of fruit that the others did; and it keeps increasing in proportion to the progress of the trees.

On the 20th of June I headed several standards that were almost destroyed by the canker; some of them were so loaded with fruit the following year, that I was obliged to prop the branches, to prevent their being broken down by the weight of it. In the fourth year after these standards were headed down, one of them bore two thousand eight hundred and forty pears. There were three standards on the same border with the above, two of which were St. Germains; the old tree was of the same kind. One of these trees *, twenty years old, had five hundred

* This tree was about six years old when I planted it, fourteen years ago.

pears on it, which was a great crop for its size; so that there were on the old tree, which had been headed down not quite four years, two thousand three hundred and forty pears more than on the tree of twenty years growth.

ESSAY XXII.

On Tares.

MANY farmers in the county of Middlesex, grow a few acres of tares, and the culture of them is extended every year, from the circumstance of their importance becoming better understood. It is a considerable degree of gratification to me, to have been the first who sowed them on a large scale, and publicly recommended them to the notice of farmers, as highly deserving to be introduced into a regular rotation of crops. After several years more experience of their utility, it is impossible for me to say so much in their favour as they

deserve. They may be made the principal means of enabling the arable farmer to support as much live stock as the grazier. For during the time they occupy the ground, they produce more green food of the best quality, per acre, than Romney-marsh or Pevensey-level; and the ground may be cleared of them in the month of June, in such good time as to admit of loamy sands producing a crop of clean turnips in the same year, and of clayey loams being prepared and sown with wheat. They support cattle; will make both sheep and bullocks, of every size and breed, fat; they suit every situation, and will flourish on all the variety of soils in this country, from the gravel-hills near Dartford, in Kent, to the stiff yellow clays in the wealds of Sussex. They do not depend on any particular market; and, above all, they manure the land fit for the immediate reception of turnips; whereby a succession of green crops can be kept up, that would fat a very increased quantity of live stock, and be the means of raising, in situations the most distant from towns, an abundance of those great sources of fertility, dung and urine. A judicious combination of tares with turnips, clover, and sainfoin, may be the means of rendering our poor sheep-walks,

downs, and wastes, of ten to thirty times their present value to the community.

1. *Preparation.*—If the land be poor, or at least not rich, manure it, otherwise not; plough it thinly into ridges, well calculated to keep it dry; sow broadcast, and harrow in the seed.

2. *Sort.*—There are two sorts; the winter tare and the spring tare. The former is the most sown, and is sufficiently hardy to stand all the changes of weather, even the severest degrees of frost ever experienced in England, or, I believe, in Great Britain.

3. *Steep.*—None used. Though, for sowing in any very dry season, it would be advisable to steep the seed.

4. *Seed.*—In the middle of the season, sow about two bushels and a half, on soils moderately rich; but early sowing and rich soils require lefs seed than poor soils and late sowing.

Many persons sow a little rye among winter tares; and some intelligent men sow a small quantity of barley among spring tares.

5. *Time of Sowing.*—From the middle of August to the middle of October. If the land be poor, or the situation exposed, by all means sow early, even in August; and in all cases, it is advisable to sow at different periods—early, medium, and late, in order to have succeſsion of them for feed the ensuing spring.

6. *Culture.*—A light roller should be drawn over them during the first dry time in March, to prepare the ground for the scythe; and the most rank weeds should be drawn by hand in April.

7. *Harvesting.*—They begin to bloſsom in May, and from that time, I am of opinion, the farmer's stock should be wholly supported on them till the bloſsoms begin to fall off, and the formation of pods to take place; at which time, all that are left should be made into hay, unleſs pods should appear in large quantities, and supposing them to be of the true winter sort. The farmer should, in that case, reserve seed enough for his own use; otherwise he should make them all into hay. If the land has been dunged, and the seed good, there will probably be a crop of twelve tons of green tares, or three tons of hay; and, provided they

are well cured, it will be the best hay on the farm. But tares require a considerable degree of sun. Rain is very injurious to them. In case a continuance of wet weather should happen after they are cut, it would be difficult to make them into hay at all, at least of a good and salutary quality. On account of this risk, I would recommend that all the stock of a farm should be soiled on them green; and in doing so, it will neceſsarily have the good effect of taking the stock off the graſs land long enough to allow of its being mown for hay. By this means the farmer's meadow hay will be much increased in quantity; he will not have occasion for pasture (the tares abundantly supplying the place of the richest pasturage), and by the time that the cattle return from green tares, the graſs land in the mean time having been mown, will be ready to receive them. I conceive that I may justly be allowed to estimate the value of tares, as if they were all made into hay, as this will be the case with a great part of them. The rest will preserve an additional quantity of meadow hay, perhaps equal to their own weight.

Spring tares produce rather a lighter crop,

and are subject to much risk from a dry summer. There is no difference in their application, or value per ton; but the spring sort coming a fortnight later, it seems to be convenient and advisable to grow some of each sort, and to have a succeſsion of them for green food all the summer.

As to the manner of giving them to cattle, it would be wasteful in the extreme to turn live stock into a field of tares, as their treading and lying down would do great mischief to the crop, even by feeding it in small patches hurdled off. The most advisable method would be, to mow the tares off the first half acre, and to carry the produce into the stables, cow-houses, and fold-yards, or on to poor land, to be consumed by stock. Then to hurdle the growing tares from such cleared ground, into which put the stock, and feed them all with the tares, given to them inracks, removing the hurdles and the racks forward daily to the edge of the growing tares, which will manure the land uniformly, and deposit all the urine in the soil. Or a very "good method, is to "feed them through rack hurdles, which are "made the same as the common five-railed "ones, only leaving the middle rail out, and

"nailing upright pieces acrofs, at proper "distances, to admit the sheep to put their "heads through. A swarth of vetches be- "ing mown in the direction you wish to "plough the land, a sufficient number of these "hurdles, allowing one to five sheep, are set "close to it: at noon the shepherd mows "another swarth, and throws it to the hurdles, "and the same at night: next morning, a "swarth being first mown, the hurdles are "again set; thus moving them once in the "twenty-four hours, by this trifling additional "trouble, the vetches are eaten clean off, and "the land equally benefited*."

8. *Thrashing*.—The seed thrashes out very readily by the flail.

9. *Produce*.—I have weighed a sufficient quantity of green tares to know, that the produce was twelve tons per acre; and when made into hay, it was three tons; which in this country is worth from twelve to fifteen guineas per acre. In more distant places, where meadow hay sells from fifty shillings to three pounds per load, the tares will be

* Gloucester Report, 4to, p. 17.

worth from seven pounds ten shillings to nine pounds per acre. The seed will sell from five shillings to twenty-one shillings per bushel. A neighbour of mine, who grew tares on my recommendation, permitted one field to stand for seed: it produced upwards of forty bushels per acre*.

It is an advantage of great importance, that turnips require such late sowing, as to give the farmer an opportunity of reaping two green crops on the same land in one year, both of which may be fed by cattle. A succeſsion of tares and turnips may be raised and consumed on dry land, till it acquires any desired degree of richneſs; and will feed more bullocks and sheep than the best graſs land in the kingdom. Romney-marsh feeds five or six sheep, per acre, per annum. An acre of loamy sand, only moderately rich, cropped with tares in the spring, and turnips in the autumn, will fatten twenty of the same sheep. And what is of great consequence, the land will be perfectly clean, and fit for every sort

* An experienced farmer in Holderneſs had no ſucceſs with winter tares till he sowed them in July. To this the north country farmers should attend. A. H.

of corn during the whole time. But they are crops that are perfectly incompatible with common fields, and for that reason, more than any other, they are so little grown in England. Inclose the common fields, and the tare and turnip husbandry will become general; which will be the most effectual means of loading our shambles with meat, and filling our granaries with corn.

ESSAY XXIII.

On the Poor Laws in Scotland.

THAT the poor, the aged, the infirm and destitute, ought to be relieved and supported by the community to which they belong, is a principal inculcated by the laws of nature and revelation, and generally enjoined by the statute-law of every well regulated society. The great object to be attended to, in the exercise of this virtuous principle, is, to draw the proper line of distinction betwixt

callousneſs of heart and indifference about the concerns of the poor (on the one hand,) and the making such liberal provisions for their support (on the other,) as to hold out a temptation to want of frugality and economy, by encouraging sloth and idleneſs, which seldom fail to produce profligacy of manners; and these in their turn, by creating want, are certain of resolving into abject meanneſs of spirit, and dependence upon others; which, of all things, tend most to degrade the character, and lead to the very evil which the public provisions for the poor was meant to correct.

These positions cannot be better illustrated, than by the opposite effects produced by the operation of the poor-laws, and their management, in the two divisions of this island.

There is no country where greater liberality is displayed by all ranks of people than in Scotland; where the poor are provided for at leſs expense; and where greater sobriety and decency prevails among that description of people, and more of that modesty and humility, becoming their situation. Whereas in England, the provision for the poor is most

exorbitant. The burden is becoming every day more intolerable, and will undoubtedly, at no distant period, rouze the attention, and call forth the vigorous interference of the legislature, to remedy a growing evil, which threatens to overwhelm the country. Besides the immensity of the sums allotted for the poor, to the amount (it is believed) of several millions a year, it is scarce to be supposed that they will, in every instance, be managed with the most perfect economy. But what, in a national view, is the worst of all; this liberal provision, which was meant for good, is productive of the very worst of evils to the poor themselves. Persons of that description, knowing that the laws of the country have made ample provision for them, when reduced by sickneſs, misfortunes, or arrived at old age, never study to exert themselves to save a small pittance of their earnings, to support them in these times of unavoidable distreſs, but squander (in riot and drunkenneſs) every sixpence that is not absolutely requisite for bare neceſsaries. The obvious consequence, therefore, of too liberal a provision for the poor, must be to increase their number; and by holding out a temptation to the neglect of economy, indirectly to corrupt their morals,

by encouraging luxury, profligacy, and every species of low debauchery.

In Scotland, except in towns, it may be truly said, that there is no provision at all for the poor; and yet there are few or no countries where they are lefs numerous, and more humanely attended to. The general views of the Scottish legislature, respecting the poor, were most just and laudible. Their aim was to guard, as far as human foresight and prudence could do, against idleneſs and profligacy, as being the immediate harbingers of povery, distreſs, and degradation. They took care to make provision for the poor, but it was only for the sober and industrious poor; while they threatened, with their utmost vengeance, all vagrants, sturdy beggars, and masterleſs persons. In the oldest laws, upon this subject, it is expreſsly ordained 'That 'none be permitted to beg betwixt the ages 'of 14 and 70, until, after examination, it be 'found that they are not able to gain a live-'lihood otherways; when they are to receive 'badges, to entitle them to beg; and all 'others are to apply themselves to work, under 'the pain of burning on the cheek, and ba-'nishment.' Acts, 1424, 1457, 1503. And

by a subsequent act, in 1535, none were permitted to beg, except in the parish where they were born. And by act 1551, none are permitted to be served with alms, except those who have badges. To encourage the same idea of industry and frugality, by an act in 1617, 'indigent children going about idle, 'may be compelled to serve any of the king's 'subjects without wages, till the age of '30 years.' And, by an act paſsed in 1663, vagrants and sturdy beggars may be also compelled to serve any manufacturer. As persons of this last description were generally of such depraved characters, and had contracted such habits of idleneſs, few were willing to receive them into their service; therefore, by an act paſsed in 1672, cap. 16. work-houses are ordained to be built for setting them to work. The acts against vagrants, and, as they are termed, 'strong and idle beggars,' are innumerable.

But while the general spirit and tendency of all the statute-laws, relating to the poor, set the strongest brand of infamy upon idleneſs and profligacy, their humanity and liberality are no leſs conspicuous. By act 1535, c. 22. the poor, who cannot work, must be

maintained by the parishes in which they were born; and when the place of their nativity is not known, it is ordained, by acts 1663, cap. 16, and 1698, cap. 21, that the burden falls upon the parishes where they have had their most common resort for the three years preceding their being apprehended, or their applying for the public charity. And this period of three years residence seems now to be generally adopted, as being that which gives a title to parish maintenance, whether the place of their nativity be known or not.

Magistrates and Judges are authorised and ordained to make up a list of the poor in their several parishes, and to send them to the parishes to which they belong, where houses are to be provided for them, at the public expense, either separately, or with others; and for their maintenance, if circumstances should so require. The whole inhabitants of the parish, without exception, are appointed to be taxed, according to their substance, for such weekly charge and contribution as shall be thought sufficient to maintain the said poor. Act 1579, cap. 74. This power of taxing for the poor, is again, by act 1663, cap. 16.

vested in the heritors, with this addition, that the poor, who are able to work, are to be offered to any within the parish, who will receive them, who are to have their work till they attain 30 years of age; and failing of being so provided for, they are to be sent to the house of correction. Confirmed by act 1672, cap. 18.

Whether it was owing to heritors becoming remiſs in taxing themselves and their tenants for the maintenance of the poor, or that any circumstance of public utility required it, it is enjoined, by an act of Privy Council, 11th Aug. 1692, that the ministers and elders of every parish shall be joined in commiſsion with the heritors, when they meet to aſseſs themselves and their tenants, for maintaining the poor; and in that act there is this important clause, 'Whoever shall give alms to 'any beggar not of the parish, and shall not 'seize (or cause to be seized) the beggar, to 'be sent back to his own parish, shall be 'fined in 20s. to be applied to the use of the 'poor.' This, and several other acts and proclamations of Privy Council, are confirmed and ratified by acts 1695, cap. 43, and 1698, cap. 21. So that this power of ministers,

elders, and heritors to meet, when neceſsary, and tax themselves and their tenants for maintaining the poor of the parish, who are unable to work, stands unrepealed in the statute-book, as a part of the statute-law for the management of the poor; and by these laws the heritors can only claim the one-half of the contributions collected at the church, to be publicly applied for that purpose.

Notwithstanding that the latest unrepealed acts of the Scottish Parliaments evidently authorise this taxing, when absolutely neceſsary, yet the good sense of the nation seems to have declined this pernicious system, at least in country parishes; and it may be now said to have nearly gone into disuse, as a measure of common and ordinary regulation. There are only a very few parishes in Scotland, where this system of taxation for the poor prevails; and these, to their sad experience, feel the bitter consequences of it, in the increase of their poor and poors rates, and all the consequent idleneſs, profligacy, and want of foresight and frugality, which must ever accompany a too liberal provision for the poor in any parish.

So little is it now supposed that there is any law existing, for obliging heritors and tenants to aſseſs themselves, for maintaining the poor, that when a farm is to be let in lease, it never once enters into the head of either the one or the other, that they will have a single shilling to pay on that account, during the continuance of the case. A tenant takes the farm as dear as if there never had been a law made to that purpose, and he sits secure, that nothing, but some extraordinary public calamity, will ever occasion these laws to be executed.

Except in the cases to be afterwards mentioned, there is, perhaps, no country in the world, where the poor are more humanely and carefully attended to, than in Scotland, and at leſs expense. From time immemorial, the contributions collected weekly, at the parish churches throughout the country, have been their only fund of support; and this fund is almost, if not altogether, left under the management of the ministers and elders of the country parishes, who receive the collections, appoint the distributions, as the neceſsities of the poor may require, meet quarterly or annually, to settle and balance their treasurer's accounts; and all this without any fee or

reward whatever, except the consciousnefs of doing good. In some parishes there are some small funds in money, arising either from former savings, or legacies bequeathed to the poor, by charitable and well-disposed persons. But even with these it would appear, from Sir John Sinclair's Statistical Account, that the expense of maintaining the poor, in country parishes, seldom reaches farther than from 10l. to 20l. a year; and yet, with this small provision, joined with the private charity of the inhabitants, the poor are well supplied and live comfortably.

The most beneficial effect of this system is, that, being in itself so small, people in the lower ranks of life, never look towards it, as their resource, under sickneſs and old age. Indeed, the accepting of charity is purely a matter of neceſsity with them, and not of choice; where it is almost invariably considered as degrading and demeaning the character, from being the effect of sloth or thriftleſsneſs in the former period of life. So great, commonly, is the horror, or aversion entertained upon this subject (of receiving charity,) that the most humiliating and unsufferable term of reproach that can be cast upon any one, is,

that their parents or near relatives were supported by the Sefsion, as it is called; that is, from the public collections at the church, which are under the management of the minister and elders of the parish, who compose the sefsion or consistory of the parish. So powerful is this sentiment among people in the lower ranks in Scotland, that, in order that this odium may never fall upon their offspring, they study to live with the utmost frugality, that they may be able to give them some education, accustom them early to habits of industry, or place them out to trades; and, at the same time, to save something for old age, and to bury them decently, without being obliged to depend on public charity at that momentous crisis. To have wherewith to purchase a coffin and a winding-sheet, if they should have nothing more, is the height of their ambition. Such is the happy influence of wise regulations, in forming the characters and manners of mankind!

It will readily be conceived, that what has been observed just now about the state of the poor, is chiefly applicable to the poor in country parishes. In cities and great towns, they are under different regulations and ma-

nagement from those in the country. From the dissipation and corruption of manners that are incident to towns, it is at once evident, that the poor will be more numerous. A combination of other circumstances may also increase their number; and it is owing to that unavoidable increase, that any thing like the English system of poor-laws takes place in Scotland. There, houses of various dimensions and descriptions are erected, and endowed for their accommodation, where they are maintained at the public expense, with almost no care or concern of their own. These erections are sometimes made and maintained from funds individually appropriated to that purpose, and others are made at the expense of the community at large, being a tax laid upon the inhabitants for their support. From one or other of these several establishments, the poor in towns are entitled to claim a maintenance.

The collections at the church, as in country parishes, being by no means adequate to the support of these expensive establishments, when these are exhausted, a tax is imposed upon the citizens, to supply the deficiency; and in consequence of this, the whole manage-

ment, and all the regulations respecting the poor, devolves upon the Magistrates, or persons authorised by them for that purpose. One of these regulations now generally adopted, is, that public begging or asking alms, in towns, is strictly prohibited. The poor are either received into the public establishments provided for them, or they receive a stipulated supply in their own houses, according as their situation may require. Many of these poor in towns, and large villages, who have been long inured to habits of profligacy and dissipation, not possessing that delicacy of sentiment above described, as peculiar to the poor in country parishes; and being either dissatisfied with the provision allotted to them, or uneasy, under the restraint of not being permitted to beg in town, sally forth, in swarms, into the country, and raise contributions by their lies, their whining, and clamorous importunity, upon the compassion and generosity of the inhabitants. And what chiefly adds to this scene of perpetual aggression and disgust, is, that it is not always upon the most necessitous and pitiable objects of distress, that these charitable contributions are bestowed; but upon a parcel of idle vagrants and vagabonds, who commonly resort with their plunder to

gin shops and dry quarters, where they indulge in all the filthy orgies, and low buffoonery and obscenity, so well described by Burns, in his poem of the *Taterdemalians*.

It is impoſsible to conceive a more disgusting nuisance, or a more pernicious evil in society, than the permiſsion of these vagrant beggars, that every day pour upon the country, like swarms of devouring locusts, from all the adjacent towns and villages. They consume the provision that ought to be applied to the parochial poor, who, if it were not for them, could be far more liberally supplied, and the burden of supporting them would never be felt. They spread and encourage vice and idleneſs, and, by the frequency of their repetitions, they chill the very feeling of charity itself. These persons ought to be considered as so many idlers, who prey upon the labours of the industrious, and by which they become doubly pernicious, both from their being non-productives, and also from their withdrawing their services from the labour of the field at a time when labourers are in much request.

There is no part of police, or of political regulation, that calls more loudly for imme-

diate redreſs than this. It is an evil that is every day increasing, and will continue to increase, in proportion as the wealth, the population, and the manufactures of the country increase in the cities and great towns. The greatest service that can be done to the state, and to the vagrant poor themselves, is, to confine them strictly within the bounds of the parishes to which they severally belong. And it is a most happy circumstance, that this can be done in the most speedy, effectual, and easy manner poſsible. The remedy needs only to be mentioned, in order to be administered.

We have seen, from the foregoing statement of the statute-law of Scotland, that all Magistrates and Justices of the Peace are empowered and enjoined to see that the poor shall be rigidly confined to the parishes to which they belong; and when they find them transgreſsing, they are charged to commit them to hard labour in the house of correction; and all who are found giving them alms, are to be fined in the sum of 20s.* for the use of the poor of their own parish.

1s. 8d. English.——Editor.

Let Justices then, at their Quarter Sessions, appoint in the first place, a considerable number of constables in every parish. Let it not only be an important part of their instructions, to apprehend vagrants, but let them regularly call the constables before them at their quarter or annual meetings, and inquire strictly into the faithful discharge of this part of their duty, and fine or punish them severely when they find them negligent. Let the constables also be obliged to give an account (upon oath, if they be desired,) if they know of any one who has given alms to any vagrant poor, and let the fines (upon all transgressors) be exacted in its fullest extent. If gentlemen would only take the trouble to do this, (and they ought positively and seriously to do it) vagrant beggars would instantly disappear in this country, as if they never had had existence.

ESSAY XXIV.

On the Changes produced by the Sea upon the Earth.

BOTH the earth and the sea appear to be in continual fluctuation. The earth, the common promptuary that supplies subsistence to men, animals, and vegetables, is continually furnishing its stores to their support. But the matter which is thus derived from it, is soon restored and laid down again to be prepared for fresh mutations. The transmigration of souls is no doubt false and whimsical; but nothing can be more certain than the transmigration of bodies: the spoils of the meanest reptile may go to the formation of a prince; and, on the contrary, as the poet has it, the body of Cæsar may be employed in stopping a beer barrel. From this, and other causes, therefore, the earth is in continual change. Its internal fires, the deviation of its rivers, and the falling of its mountains, are daily altering its surface; and geography can scarcely recollect the lakes and the vallies that history once described.

But these changes are nothing to the instability of the ocean. It would seem that inquietude was as natural to it as its fluidity. It is first seen with a constant and equable motion going towards the west; the tides then interrupt this progreſsion, and for a time drive the waters in a contrary direction; beside these agitations, the currents act their part in a smaller sphere, being generally greatest where the other motions of the sea are least; namely, nearest the shore: the winds also contribute their share in this universal fluctuation; so that scarce any part of the sea is wholly seen to stagnate.

As this great element is thus changed, and continually labouring internally, it may be readily supposed that it produces correspondent changes upon its shores, and those parts of the earth subject to its influence. In fact, it is every day making considerable alterations, either by overflowing its shores in one place, or deserting them in others; by covering over whole tracts of country, that were cultivated and peopled, at one time; or by leaving its bed to be appropriated to the purposes of vegetation, and to supply a new theatre for human industry at another.

In this struggle between the earth and the sea for dominion, the greatest number of our shores seem to defy the whole rage of the waves, both by their height, and the rocky materials of which they are composed. The coasts of Italy, for instance, are bordered with rocks of marble of different kinds, the quarries of which may easily be distinguished at a distance from sea, and appear like perpendicular columns, of the most beautiful kinds of marble, ranged along the shore. In general, the coasts of France, from Brest to Bourdeaux, are composed of rocks; as are also those of Spain and England, which defend the land, and only are interrupted here and there to give an egress to rivers, and to grant the conveniences of bays and harbours to our shipping. It may be in general remarked, that wherever the sea is most violent and furious, there the boldest shores, and of the most compact materials, are found to oppose it. There are many shores several hundred feet perpendicular, against which the sea, when swollen with tides or storms, rises and beats with inconceivable fury. In the Orkneys, where the shores are thus formed, it sometimes, when agitated by a storm, rises two hundred feet perpendicular,

and dashes up its spray, together with sand, and other substances that compose its bottom, upon land, like showers of rain.

From hence, therefore, we may conceive how the violence of the sea, and the boldneſs of the shore, may be said to have made each other. Where the sea meets no obstacles, it spreads its waters with a gentle intumescence, till all its power is destroyed, by its wanting depth to aid its motion. But when its progreſs is checked in the midst, by the prominence of rocks, or the abrupt elevation of the land, it dashes with all the force of its depth against the obstacle, and forms, by its repeated violence, that abruptneſs of the shore which confines its impetuosity. Where the sea is extremely deep, or very much vexed by tempests, it is no small obstacle that can confine its rage; and for this reason we see the boldest shores projected against the deepest waters; all leſs impediments having long before been surmounted and washed away. Perhaps of all the shores in the world, there is not one so high as that to the west of St. Kilda, which, upon a late admeasurement, was found to be six hundred fathom perpendicular above the surface of the sea. Here also, the sea is deep,

turbulent, and stormy; so that it requires great force in the shore to oppose its violence. In many parts of the world, and particularly upon the coasts of the East Indies, the shores, though not high above water, are generally very deep, and consequently the waves roll against land with great weight and irregularity. This rising of the waves against the shore, is called by mariners, the surf of the sea; and in shipwrecks is generally fatal to such as attempt to swim on shore. In this case, no dexterity in the swimmer, no float he can use, neither swimming girdle nor cork jacket will save him; the weight of the superincumbent wave breaks upon him at once, and crushes him with certain ruin. Some few of the natives, however, have the art of swimming and of navigating their little boats near those shores, where an European is sure of instant destruction.

In places where the force of the sea is leſs violent, or its tides leſs rapid, the shores are generally seen to descend with a more gradual declivity. Over these, the waters of the tide steal by almost imperceptible degrees, covering them for a large extent, and leaving them bare on its receſs. Upon these shores, as was

said, the sea seldom beats with any great violence, as a large wave has not depth sufficient to float it onwards, so that here only are to be seen gentle surges making calmly towards land, and leſsening as they approach. As the sea, in the former description, is generally seen to present prospects of tumult and uproar, here it more usually exhibits a scene of repose and tranquil beauty. Its waters, which when surveyed from the precipice, afforded a muddy, greenish hue, arising from their depth and position to the eye, when regarded from a shelving shore, wear the colour of the sky, and seem rising to meet it. The deafening noise of the deep sea, is here converted into gentle murmurs; instead of the water's dashing against the face of the rock, it advances and recedes, still going forward, but with just force enough to push its weeds and shells, by insensible approaches to the shore.

There are still other shores, besides those already described, which either have been raised by art to oppose the sea's approaches, or from the sea's gaining ground, are threatened with imminent destruction. The sea's being thus seen to give and take away lands at pleasure, is, without question, one of the

most extraordinary considerations in all natural history. In some places it is seen to obtain the superiority by slow and certain approaches; or to burst in at once, and overwhelm all things in undistinguished destruction; in other places it departs from its shores; and where its waters have been known to rage, it leaves fields covered with the most beautiful verdure.

The formation of new lands by the sea's continually bringing its sediment to one place, and by the accumulation of its sands in another, is easily conceived. We have had many instances of this in England. The island of Oxney, which is adjacent to Romney-marsh, was produced in this manner. This had for a long time been a low level, continually in danger of being overflown by the river Rother; but the sea, by its depositions, has gradually raised the bottom of the river, while it has hollowed the mouth; so that the one is sufficiently secured from inundations, and the other is deep enough to admit ships of considerable burden. The like also may be seen at that bank called the Dogger-sands, where two tides meet, and which thus receive new increase every day, so that in time the place

seems to promise fair for being habitable earth. On many parts of the coasts of France, England, Holland, Germany, and Prusia, the sea has been sensibly known to retire*. Hubert Thomas asserts, in his Description of the Country of Liege, that the sea formerly encompased the city of Tongres, which, however, is at present thirty-five leagues distant from it: this assertion he supports by many strong reasons; and among others, by the iron rings fixed in the walls of the town, for fastening the ships that came into the port. In Italy there is a considerable piece of ground gained at the mouth of the river Arno; and Ravenna, that once stood by the sea-side, is now considerably removed from the same. But we need scarce mention these, when we find that the whole republic of Holland seems to be a conquest upon the sea, and, in a manner, rescued from its bosom. The surface of the earth, in this country, is below the level of the bed of the sea; and I remember, upon approaching the coast, to have looked down upon it from the sea, as into a valley; however it is every day rising higher by the deposi-

* Buffon, vol. vi. p. 424.

tions made upon it both by the sea, the Rhine, and the Meuse; and those parts which formerly admitted large men of war, are now known to be too shallow to receive ships of very moderate burden*. The province of Jucatan, a peninsula in the Gulph of Mexico, was formerly a part of the sea: this tract, which stretches out into the ocean 100 leagues, and which is above thirty broad, is every where, at a moderate depth below the surface, composed of shells, which evince that its land once formed the bed of the sea. In France, the town of Aigues Mortes was a port in the time of St. Louis, which is now removed more than four miles from the sea. Psalmodi, in the same kingdom, was an island in the year 815, but is now more than six miles from the shore. All along the coasts of Norfolk, I am very well assured, that in the memory of man, the sea has gained fifty yards in some places, and lost as much in others

Thus numerous, therefore, are the instances of new lands having been produced from the ocean, which, as we see, is brought about two different ways: first, by the waters raising

* Buffon, vol. vi. 424.

banks of sand and mud where their sediment is deposited; and, secondly, by their relinquishing the shore entirely, and leaving it unoccupied to the industry of man.

But as the sea has been thus known to recede from some lands, so has it, by fatal experience, been found to encroach upon others; and, probably, these depredations on one part of the shore, may account for their dereliction from another; for the current which rested upon some certain bank, having got an egress in some other place, it no longer presses upon its former bed, but pours all its stream into the new entrance; so that every inundation of the sea may be attended with some correspondent dereliction of another shore.

However this be, we have numerous histories of the sea's inundations, and its burying whole provinces in its bosom. Many countries that have been thus destroyed, still bear melancholy witness to the truth of history; and show the tops of their houses, and the spires of their steeples, still standing at the bottom of the water. One of the most considerable inundations we have in history, is that which happened in the reign of Henry I. which

overflowed the estates of the Earl Godwin, and forms now that bank called the Goodwin Sands. In the year 1546, a similar eruption of the sea destroyed a hundred thousand persons in the territory of Dort; and yet a greater number round Dullart. In Friezland, and Zealand, there were more than three hundred villages overwhelmed; and their ruins continue still visible at the bottom of the water in a clear day. The Baltic sea has, by slow degrees, covered a large part of Pomerania; and, among others, destroyed and overwhelmed the famous port of Vineta. In the same manner, the Norwegian sea has formed several little islands from the main-land, and still daily advances upon the continent. The German sea has advanced upon the shores of Holland, near Catt; so that the ruins of an ancient citadel of the Romans, which was formerly built upon this coast, are now actually under water. To these accidents several more might be added; our own historians, and those of other countries, abound with them; almost every flat shore of any extent, being able to show something that it has lost, or something that it has gained from the sea.

There are some shores on which the sea has

made temporary depredations; where it has overflowed, and after remaining perhaps some ages, it has again retired of its own accord, or been driven back by the industry of man. There are many lands in Norway, Scotland, and the Maldivia Islands, that are at one time covered with water, and at another free. The country round the Isle of Ely, in the time of Bede, about a thousand years ago, was one of the most delightful spots in the whole kingdom; it was not only richly cultivated, and produced all the neceſsaries of life, but grapes also, that afforded the most excellent wine. The accounts of that time are copious in the description of its verdure and fertility; its rich pastures covered with flowers and herbage; its beautiful shades, and wholesome air. But the sea, breaking in upon the land, overwhelmed the whole country, took poſseſsion of the soil, and totally destroyed one of the most beautiful vallies in the world. Its air, from being dry and healthful, from that time became most unwholesome, and clogged with vapours; and the small part of the country that, by being higher than the rest, escaped the deluge, was soon rendered uninhabitable, from its noxious vapours. Thus this country continued under water for some centuries;

till, at last the sea, by the same caprice which had prompted its invasions, began to abandon the earth in like manner. It has continued for some ages to relinquish its former conquests; and although the inhabitants can neither boast the longevity, nor the luxuries of their former pre-occupants, yet they find ample means of subsistence: and if they happen to survive the first years of their residence there, they are often known to arrive at a good old age.

But although history be silent as to many other inundations of the like kind, where the sea has overflowed the country, and afterwards retired, yet we have numberleſs testimonies of another nature, that prove it beyond the poſsibility of doubt: I mean those numerous trees that are found buried at considerable depths in places where either rivers, or the sea, has accidentally overflown. At the mouth of the river Neſs, near Bruges, in Flanders, at the depth of fifty feet, are found great quantities of trees lying as close to each other as they do in a wood: the trunks, the branches, and the leaves, are in such perfect preservation, that the particular kind of each tree may instantly be known. About five hundred years ago,

this very ground was known to have been covered with the sea; nor is there any history or tradition of its having been dry ground, which we can have no doubt must have been the case. Thus we see a country flourishing in verdure, producing large forests, and trees of various kinds, overwhelmed by the sea. We see this element depositing its sediment to an height of fifty feet; and its waters must, therefore, have risen much higher. We see the same, after it has thus overwhelmed, and sunk the land so deep beneath its slime, capriciously retiring from the same coasts, and leaving that habitable once more, which it had formerly destroyed. All this is wonderful; and perhaps, instead of attempting to inquire after the cause, which has hitherto been inscrutable, it will best become us to rest satisfied with admiration.

At the city of Modena in Italy, and about four miles round it, wherever it is dug, when the workmen arrive at the depth of sixty-three feet, they come to a bed of chalk, which they bore with an augre five feet deep: they then withdraw from the pit, before the augre is removed, and upon its extraction, the water bursts up through the aperture with great

violence, and quickly fills this new-made well, which continues full, and is affected neither by rains nor droughts. But that which is most remarkable in this operation, is the layers of earth as we descend. At the depth of fourteen feet, are found the ruins of an ancient city, paved streets, houses, floors, and different pieces of Mosaic. Under this is found a solid earth, that would induce one to think had never been removed; however, under it is found a soft oozy earth, made up of vegetables; and at twenty-six feet depth, large trees entire, such as walnut-trees, with the walnuts still sticking on the stem, and their leaves and branches in exact preservation. At twenty-eight feet deep, a soft chalk is found, mixed with a vast quantity of shells; and this bed is eleven feet thick. Under this, vegetables are found again, with leaves, and branches of trees as before; and thus alternately chalk and vegetable earth to the depth of sixty-three feet. These are the layers wherever the workmen attempt to bore; while in many of them they also find pieces of charcoal, bones, and bits of iron. From this description, therefore, it appears, that this country has been alternately overflowed and deserted by the sea, one age after another:

nor were these overflowings and retirings of of trifling depth, or of short continuance. When the sea burst in, it must have been a long time in overwhelming the branches of the fallen forest with its sediment; and still longer in forming a regular bed of shells eleven feet over them. It must have, therefore, taken an age, at least, to make any one of these layers; and we may conclude, that it must have been many ages employed in the production of them all. The land also, upon being deserted, must have had time to grow compact, to gather fresh fertility, and to be drained of its waters before it could be disposed to vegetation, or before its trees could have shot forth again to maturity.

We have instances nearer home of the same kind, given us in the Philosophical Transactions; one of them by Mr. Derham. An inundation of the sea, at Degenham, in Eſsex; laying bare a part of the adjacent pasture for above two hundred feet wide, and, in some places, twenty deep, it discovered a number of trees that had lain there for many ages before; these trees, by lying long under ground, were become black and hard, and their fibres so tough, that one might as easily break a

wire, as any of them: they lay so thick in the place where they were found, that in many parts he could step from one to another: he conceived also, that not only all the adjacent marshes, for several hundred acres, were covered underneath with such timber, but also the marshes along the mouth of the Thames, for several miles. The meeting with these trees at such depths, he ascribes to the sediment of the river and the tides, which constantly washing over them, have always left some part of their substance behind, so as, by repeated alluvions, to work a bed of vegetable earth over them, to the height at which he found it.

The levels of Hatfield-Chace, in Yorkshire, a tract of above eighteen thousand acres, which was yearly overflown, was reduced to arable and pasture-land, by one Sir Cornelius Vermusden, a Dutchman. At the bottom of this wide extent, are found millions of the roots and bodies of trees, of such as this island either formerly did, or does at present produce. The roots of all stand in their proper postures; and by them, as thick as ever they could grow, the respective trunks of each, some above thirty yards long. The oaks, some

of which have been sold for fifteen pounds a piece, are as black as ebony, very lasting, and close grained. The ash-trees are as soft as earth, and are commonly cut in pieces by the workmen's spades, and as soon as flung up into the open air, turn to dust. But all the rest, even the willows themselves, which are softer than the ash, preserve their substance and texture to this very day. Some of the firs appear to have vegetated, even after they were fallen, and to have, from their branches, struck up large trees, as great as the parent trunk. It is observable, that many of these trees have been burnt, some quite through, some on one side, some have been found chopped and squared, others riven with great wooden wedges, all sufficiently manifesting, that the country which was deluged, had formerly been inhabited. Near a great root of one tree, were found eight coins of the Roman emperors; and, in some places, the marks of the ridge and furrow, were plainly perceivable, which testified that the ground had formerly been patient of cultivation.

The learned naturalist who has given this description *, has pretty plainly evinced, that

* Phil. Trans. vol. iv. part ii. p. 214.

this forest, in particular, must have been thus levelled by the Romans; and that the falling of the trees, must have contributed to the accumulation of the waters. "The Romans," says he, "when the Britons fled, always pursued them into the fortreſses of low woods and miry forests: in these, the wild natives found shelter; and, when opportunity offered, iſsued out, and fell upon their invaders without mercy. In this manner the Romans were at length so haraſsed, that orders were iſsued out for cutting down all the woods and forests in Britain. In order to effect this, and destroy the enemy the easier, they set fire to the woods, composed of pines and other inflammable timber, which spreading, the conflagration destroyed not only the forest, but infinite numbers of the wretched inhabitants who had taken shelter therein. When the pine-trees had thus done what mischief they could, the Romans then brought their army nearer, and with whole legions of the captive Britons, cut down most of the trees that were yet left standing; leaving only here and there some great trees untouched, as monuments of their fury. These, unneedful of their labour, being destitute of the support of the underwood, and of their neighbouring trees,

were easily overthrown by the winds, and, without interruption, remained on the places where they happened to fall. The forest, thus fallen, must neceſsarily have stopped up the currents, both from land and sea; and turned into great lakes, what were before but temporary streams. The working of the waters here, the consumption and decay of rotten boughs and branches, and the vast increase of water-moſs, which flourishes upon marshy grounds, soon formed a covering over the trunks of the fallen trees, and raised the earth several feet above its former level. The earth thus every day swelling, by a continual increase from the sediment of the waters, and by the lightneſs of the vegetable substances of which it was composed, soon overtopt the waters by which this intumescence was at first effected; so that it entirely got rid of its inundations, or only demanded a slight aſsistance from man for that purpose." And this may be the origin of all bogs whatsoever, which are formed by the putrefaction of vegetable substances, mixed with the mud and slime deposited by waters, and at length acquiring a sufficient consistency.

From this we see what powerful effects the

sea is capable of producing upon its shores, either by overflowing some, or deserting others; by altering the direction of these, and rendering those craggy and precipitate, which before were shelving. But the influence it has upon these, is nothing to that which it has upon that great body of earth which forms its bottom. It is at the bottom of the sea that the greatest wonders are performed, and the most rapid changes are produced; it is there that the motion of the tides and the currents have their whole force, and agitate the substances of which their bed is composed. But all these are almost wholly hid from human curiosity: the miracles of the deep are performed in secret; and we have but little information from its abyſses, except what we receive by inspection at very shallow depths, or by the plummet, or from divers, who are known to descend from twenty to thirty fathoms*.

The eye can reach but a very short way into the depths of the sea; and that only when its surface is glaſsy and serene. In many seas it perceives nothing but a bright sandy plain at

* Phil. Trans. vol. iv. part ii. p. 192.

bottom, extending for several hundred miles, without an intervening object. But in others, particularly in the Red Sea, it is very different: the whole bottom of this extensive bed of waters is, literally speaking, a forest of submarine plants, and corals formed by insects for their habitation, sometimes branching out to a great extent. Here are seen the madrepores, the sponges, moſses, sea mushrooms, and other marine productions, covering every part of the bottom: so that some have even supposed the sea to have taken its name from the colour of its plants below. However, these plants are by no means peculiar to this sea, as they are found in great quantities in the Persian gulph, along the coasts of Africa, and those of Provence and Catalonia.

The bottom of many parts of the sea near America, presents a very different, though a very beautiful appearance. This is covered with vegetables, which make it look as green as a meadow, and beneath are seen thousands of turtles, and other sea-animals, feeding thereon.

In order to extend our knowledge of the sea to greater depths, recourse has been had

to the plummet; which is generally made of a lump of lead of about forty pounds weight, fastened to a cord. This, however, only answers in moderate depths; for when a deep sea is to be sounded, the matter of which the cord is composed, being lighter than the water, floats upon it, and when let down to a considerable depth, its length so increases its surface, that it is often sufficient to prevent the lead from sinking; so that this may be the reason that some parts of the sea are said to have no bottom.

In general, we learn from the plummet, that the bottom of the sea is tolerably even, where it has been examined; and that the farther from the shore, the sea is in general the deeper. Notwithstanding, now and then, in the midst of a great and unfathomable ocean, we often find an island raising its head, and singly braving its fury. Such islands may be considered as the mountains of the deep; and, could we for a moment imagine the waters of the ocean removed or dried away, we should probably find the inequalities of its bed resembling those that are found at land. Here extensive plains; there valleys; and, in many places, mountains of amazing height.

M. Buache has actually given us a map of that part of its bottom, which lies between Africa and America, taken from the several soundings of mariners: in it we find the same uneven surface that we do upon land, the same eminences, and the same depreſsions. In such an imaginary prospect, however, there would be this difference, that as the tops of land-mountains appear the most barren and rocky, the tops of sea-mountains would be found the most verdant and fruitful.

The plummet, which thus gives us some idea of the inequalities of the bottom, leaves us totally in the dark as to every other particular; recourse, therefore, has been had to divers: these, either being bred up in this dangerous way of life, and accustomed to remain some time under water without breathing, or aſsisted by means of a diving-bell, have been able to return some confused and uncertain accounts of the places below. In the great diving-bell improved by Dr. Halley, which was large enough to contain five men, and was supplied with fresh air by buckets, that alternately rose and fell, they descended fifty fathoms. In this huge machine, which was let down from the mast of the ship, the

doctor himself went down to the bottom, where, when the sea was clear, and especially when the sun shone, he could see perfectly well to write or read, and much more to take up any thing that was underneath: at other times, when the water was troubled and thick, it was as dark as night below, so that he was obliged to keep a candle lighted at the bottom. But there is one thing very remarkable, which is, that the water which from above was usually seen of a green colour, when looked at from below, appeared to him of a very different one, casting a redness upon one of his hands, like that of damask roses*:—A proof of the sea's taking its colour not from any thing floating in it, but from the different reflections of the rays of light. Upon the whole, the accounts we have received from the bottom, by this contrivance, are but few. We learn from it, and from divers in general, that while the surface of the sea may be deformed by tempests, it is usually calm and temperate below†; that some divers who have gone down when the weather was calm, and came up when it was tempestuous, were

* Newton's Optic, p. 56.

† Boyle, vol. iii. p. 242.

surprised at their not perceiving the change at the bottom. This, however, must not be supposed to obtain with regard to the tides and the currents, as they are seen constantly shifting their bottom; taking their bed with great violence from one place, and depositing it upon another. We are informed, also, by divers, that the sea grows colder in proportion as they descend to the bottom: that as far as the sun's rays pierce, it is influenced by their warmth; but lower, the cold becomes almost intolerable. A person of quality, who had been himself a diver, as Mr. Boyle inform us, declared, that though he seldom descended above three or four fathoms, yet he found it so much colder than nearer the top, that he could not well endure it; and that being let down in a great diving-bell, although the water could not immediately touch him, he found the air extremely cold upon his first arrival at the bottom.

From divers also we learn, that the sea in many places is filled with rocks at bottom; and, that among their clifts, and upon their sides, various substances sprout forward, which are either really vegetables, or the nests of insects, increased to some magnitude.

Some of these aſsume the shape of beautiful flowers; and, though soft, when taken up, soon harden, and are kept in the cabinets of the curious.

But, of all those divers who have brought us information from the bottom of the deep, the famous Nicola Pesce, whose performances are told us by Kircher, is the most celebrated. I will not so much as pretend to vouch for the veracity of Kircher's account, which he aſsures us he had from the archives of the kings of Sicily. "In the times of Frederic, king of Sicily, there lived a celebrated diver, whose name was Nicolas, and who, from his amazing skill in swimming, and his perseverance under water, was sirnamed the *Fish*. This man had, from his infancy, been used to the sea; and earned his scanty subsistence by diving for corals and oysters; which he sold to the villages on shore. His long acquaintance with the sea, at last, brought it to be almost his natural element. He frequently was known to spend five days in the midst of the waves, without any other provisions than the fish which he caught there, and ate raw. He often swam over from Sicily to Calabria, a tempestuous and dangerous paſsage, carry-

ing letters from the king. He was frequently known to swim among the gulphs of the Lipari islands, no way apprehensive of danger.

"Some mariners out at sea, one day observed something at some distance from them, which they regarded as a sea-monster; but upon its approach, it was known to be Nicolas, whom they took into their ship. When they asked him whither he was going in so stormy and rough a sea, and at such a distance from land, he showed them a packet of letters, which he was carrying to one of the towns of Italy, exactly done up in a leather bag, in such a manner as that they could not be wetted by the sea. He kept them thus company for some time on their voyage, conversing and asking questions; and after eating a hearty meal with them, he took his leave, and jumping into the sea, pursued his voyage alone.

"In order to aid these powers of enduring in the deep, Nature seemed to have afsisted him in a very extraordinary manner; for the spaces between his fingers and toes were webbed, as in a goose; and his chest became so very capacious, that he could take in at one inspiration, as much breath as would serve him for a whole day.

"The account of so extraordinary a person did not fail to reach the king himself; who, actuated by the general curiosity, ordered that Nicholas should be brought before him. It was no easy matter to find Nicholas, who generally spent his time in the solitudes of the deep; but, at last, however, after much searching, he was found, and brought before his Majesty. The curiosity of this monarch had been long excited by the accounts he had heard of the bottom of the gulph of Charybdis; he therefore conceived that it would be a proper opportunity to have more certain information; and commanded our poor diver to examine the bottom of this dreadful whirlpool; and as an incitement to his obedience, he ordered a golden cup to be flung into it. Nicolas was not insensible of the danger to which he was exposed; dangers best known only to himself; and he therefore presumed to remonstrate: but the hopes of the reward, the desire of pleasing the king, and the pleasure of showing his skill, at last prevailed. He instantly jumped into the gulph, and was swallowed as instantly up in its bosom. He continued for three quarters of an hour below; during which time the king and his attendants remained upon shore anxious for his fate; but

he at last appeared, buffeting upon the surface, holding the cup in triumph in one hand, and making his way good among the waves with the other. It may be supposed he was received with applause upon his arrival on shore; the cup was made the reward of his adventure; the king ordered him to be taken proper care of; and, as he was somewhat fatigued and debilitated by his labour, after a hearty meal, he was put to bed, and permitted to refresh himself by sleeping.

"When his spirits were thus restored, he was again brought to satisfy the king's curiosity, with a narrative of the wonders he had seen; and his account was to the following effect:—He would never, he said, have obeyed the king's commands, had he been apprized of half the dangers that were before him. There were four things, he said, that rendered the gulph dreadful, not only to men, but even to the fishes themselves: first, the force of the water bursting up from the bottom, which required great strength to resist; secondly, the abruptnefs of the rocks, that on every side threatened destruction; thirdly, the force of the whirlpool, dashing against those rocks; and fourthly, the number and magnitude of

the polypus fish, some of which appeared as large as a man, and which, every where sticking against the rocks, projected their fibrous arms to entangle him. Being asked how he was able so readily to find the cup that had been thrown in, he replied, that it happened to be flung by the waves into the cavity of a rock, against which he himself was urged in his descent. This account, however, did not satisfy the king's curiosity; being requested to venture once more into the gulph for further discoveries, he at first refused; but the king, desirous of having the most exact information poſsible of all things to be found in the gulph, repeated his solicitations; and, to give them still greater weight, produced a larger cup than the former, and added also a purse of gold. Upon these considerations, the unfortunate Peſsacola once again plunged into the whirlpool, and was never heard of more."

ESSAY XXV.

On Local Agriculture.

FARMERS who have been confined to one district, ought to be cautious how they criticise, with contemptuous asperity, the general conduct of those of another district, poſſeſſing a ſoil of a different nature, or in a different state from their own. I hardly know a more helpleſs creature, or one who would deserve more to be pitied, than a mere practical farmer, who should move from a rich highly improved soil, in a good climate, to poſſeſs a farm in an unimproved country, where the soil and climate were naturally bad, and manures without his reach.—If this observation be well founded, ought it not to make us entertain a doubt, if the practice lately introduced into some of the unimproved parts of Scotland, of gentlemen sending their sons to the most improved counties in England, to learn the practice of agriculture, will be attended with all the beneficial consequences that are at first expected to arise from it?—In

an unimproved country, a farmer has numberleſs difficulties to encounter, that are not known or dreamed of in one where agriculture has been long practised with succeſs.—And is it in the lap of ease, and in the midst of abundance, that one learns best to suffer hardships with fortitude, and overcome difficulties by perseverance? Is it within the walls of a garrison, that a general may best learn the art of war? or is it not rather in the field, where dangers surround him on every hand, while opposed by a vigilant and active commander, that he learns the much prized art of destruction?—It is nearly the same with a farmer in an unimproved country.—He is surrounded with so many difficulties—meets with such powerful interruptions at every step—and must proceed so slowly and cautiously in all his operations, as would totally overcome the spirit of one who had been accustomed to live in a happier situation.—If one hopes to practise farming in these circumstances with the smallest prospect of succeſs, he must not only be poſseſsed of a sagacious penetration, in distinguishing, with precision, the nature of the different soils he may meet with, and the crops that each of these will best carry, but a solidity of judgment, and an

unbiafsed impartiality of mind, that may enable him to vary his practice so as to suit the nature of that soil, and make it produce, perhaps, the only crop that it is fitted to rear: —A species of knowledge that must be self-taught—as neither the experience of his ancestors—his neighbours—nor the best farmers, in another situation, can avail him any thing.—He must likewise be poſseſsed of a coolneſs of temper, that is not apt to be startled at meeting with unforeseen obstructions, and an obstinate industry that persists till these are overcome, however great and numerous they may be—a versatility of genius, fitted to adapt itself at once to the circumstances that may occur, so as to seize every advantage that fortune may throw in his way—a patient forbearance, and vigilant foresight, that may perceive difficulties at a distance, so as to guard against them before they come to preſs with irresistible power—and a moderation in his desires, that can be contented with little on all occasions.

With all these qualities, a man, in many situations, may be reckoned fortunate, if, after a long life spent in the most vigorous exertions, and persevering industry, he can

bring his fields into such order, as barely to admit of beginning to introduce some of those modes of culture that were fully established in the improved district, which was proposed as a model to him in his early years. Is it proper to send a young man, who has such a rugged scene to encounter, to the smooth and fertile fields of plenty?—Is it fit to inspire his youthful mind with a taste of those sweets which he is doomed never to enjoy?—Is it wise to send one to learn to overcome difficulties, to a place where none of these difficulties ever occur?—Is not such a plan apt to inspire the youthful mind with a vain and presumptuous confidence of succeſs, that is in danger of making it engage in chimerical plans of improvement which never can be realised—which end in disappointment and chagrin—perhaps in utter ruin and misery!

I have been induced to delineate this faithful picture, from having seen it too fatally realized in more instances than one;—and from having observed that some writers of late have exerted themselves to the utmost, to endeavour to promote such chimerical projects.—It is painful to see individuals hurt, by improper ideas getting poſseſsion of their mind.

Those who have been accustomed to live in the regions of plenty—of industry and knowledge—who have been used to see abundant crops waving in luxuriance on their fields—who look with contempt on the unskilfulness, and laugh at what they deem the puny attempts at improvement of those who live in barren countries, will, no doubt, accuse me of prejudice, should I give it as my opinion, that, with half the genius—half the application and industry—half the knowledge—half the money, and one-tenth of the time, a farmer who lives in a rich country, already forward in culture, may bring all his fields into such order as to carry onions, or any other garden crop, before one who, in certain circumstances, undertakes to improve barren and uncultivated ground, will be able to bring it to bear tolerable crops of any kind of corn or grass. Yet, if I can trust to my own most attentive observation and experience, this is undoubtedly the case.

Let it not, however, be imagined, I mean to insinuate that a farmer can gain no advantage by travelling into a country where there are more improvements than in that where he resides.—Nothing can be farther from my

intention.—I would only wish to inculcate this useful maxim, which might with justice be applied to all kinds of travelling.—That it is not the young and inexperienced who can be properly instructed by this means—but those who have already made some progreſs in those arts or sciences they wish to be instructed in—whose experience has taught them caution, and whose habit of attention has enabled them to select with judgment, and adopt with a wise discrimination, such particulars only as they know can be applied to their own particular purposes—and reject the others as useleſs or pernicious.

ESSAY XXVI.

On Raising the Oak.

An opinion is generally prevalent, that the Oak is particularly slow in its growth, and requires a great number of years before it affords any advantage. This idea too often deters from planting, on account of the very great length of time it is supposed the land must be occupied before any return of valuable produce can be obtained from it, after a considerable expense may have been incurred in forming plantations.

This opinion I consider as entirely founded in error, and to have taken its rise in a great measure from the want of proper management that has hitherto commonly prevailed in the raising of Oaks: and in this Essay I shall endeavour strongly to state, that the Oak may be rendered very rapid in its growth, and that consequently land may be employed to great advantage in its cultivation, as a very considerable and profitable produce may, in a

much shorter time than is generally supposed, be derived from proper parts of an estate thus employed.

Oak-Timber in this country, for the most part, appears in trees of a considerable extent of head, but seldom more than twenty or thirty feet in stem; and this, in many instances, the growth of a century. Now, by the course of management here proposed, it is conceived that trees, of at least double this magnitude, may be obtained in about half that time.

It is not my intention to attempt a proof of this proposition by theoretical deductions, but to appeal for its confirmation to the indubitable test of fact, which, from the event of repeated trials, impreſses a conviction, that experience will be found to support and establish it in the most unequivocal manner.

It would be easy to enlarge much on the various qualities of soil, the nature and proceſs of vegetation, and the peculiar properties of the Oak; but as these topics may be found amply and judiciously discuſsed in many other authors, who have expreſsly treated on these

subjects, I shall decline all such speculations; and, with the hope of being more eſsentially useful, shall confine myself to a statement as simple and practical as poſsible.

The Oak, in the progreſs of its growth, spreads numerous roots near the surface of the ground, and in a horizontal direction: these aſsist in supporting and preserving the tree in its position, but seem to contribute very little to its increase and magnitude. The Oak appears to derive its chief nutriment and strength from a root that always descends at right angles to the horizon, and is called the tap-root. The first thing, therefore, to be observed is, that upon a judicious attention to this peculiarity, the planter's succeſs principally depends; and the neglect of this care is the constant source of error and disappointment. In all climates, and upon all soils, to preserve this tap-root from injury, and as much as poſsible to aſsist its growth, is a general, and indeed the most eſsential principle in the cultivation of Oak. With a due regard to this circumstance, the management of a plantation may be resolved into the three following practical directions:

Previously to planting the acorns, loosen the earth intended for their reception by deep trenching.

Never transplant, or in any way disturb, the saplings intended for timber.

Keep the plant carefully pruned, till arrived at a proper height.

More fully to elucidate the subject, and to prevent the posſibility of misapprehension, it may be proper to give a more detailed statement.

In determining on a spot to form a plantation of Oaks for timber, it must always be recollected that the plants are to remain without removal in their first situation; the clearing and fencing may then be attended to as usual; and in the course of the winter, from September to March, the particular spots intended for the reception of acorns, may be prepared for that purpose, by digging a trench about three feet in width, and from three to six feet in depth, according to the closeneſs and tenacity of the soil. If graſs-ground, the first spit should be placed at the bottom of

the trench; and if more than one trench be necefsary, they should be prepared in the same manner, preserving a distance of ten yards between each, if it be intended to employ the intermediate space in underwood, or for any other purpose.

Having made a careful selection of acorns that are perfectly sound, and in good preservation, they are to be planted about the middle of March. Draw a drill in the centre of the trench; two inches in depth, if the soil be heavy and loamy; but three inches in a light and sandy earth. In this place the acorns two inches asunder, and cover them carefully with mould. When the plants appear, they must be weeded by hand in the rows, and the earth of the trench round them cleaned with a hoe, once a month during the summer. In October inspect the rows, and thin them by pulling up every other plant; attention will of course be paid to remove the weak and crooked plants, and leave those that are tallest and straitest. On the second year, the operation of thinning must be repeated, at the same time, and in the same manner; and, should any of the remaining plants have made side-shoots stronger than

the general character, they must be smoothly cut off with a sharp knife, close to the leading stem. On the third year, the thinning is again to be repeated, and the general pruning commenced, by cutting off close to the leading stem all the side-shoots of the first year; thus leaving the branches of two years to form the head of the following year. The removal of every alternate plant must be continued yearly, till the trees are about thirty feet apart, at which distance they may remain for timber. The pruning is to be continued, by removing every year, very smooth and close to the main stem, one year's growth of side branches, till the plants are arrived at a stem of forty, fifty, or sixty feet, and they may then be permitted to run to head without further pruning.

The particular arrangement here recommended may be varied according to any peculiarities of situation, regard being constantly had to the general and most important principle of loosening the ground very deep previously to planting the acorns. By this mode of culture, Oaks may be raised in almost any soil; but, where it is pofsible, a loam or marl is always to be chosen. Oaks thrive

much the best in such earth; and, when assisted by deep trenching and judicious pruning, attain in a few years to an immense size.

Those who have been accustomed to notice the slow growth and stunted appearance of Oak Trees, when denied the assistance of art, and left to themselves in the common way, would observe with astonishment the vigorous and rapid increase of plants under the management now pointed out.

The plants thinned out the first three or four years, though not fit to be depended upon for timber, as transplanting generally injures very materially the future growth, may be replanted in the intermediate spaces between the rows, for the purpose of being afterwards removed; or they may be usefully placed in hedges, or other spare and unoccupied spots of ground. They should be headed down at the time of transplanting, as this operation assists the process of nature, in reproducing or remedying any injury the tap-root may have received from the removal: and, if proper attention be given to loosening the soil for their reception, and pruning them

as they advance, in most instances an adequate profit will be derived from the labour bestowed upon them. After a few years, the produce of the timber-plantation will be found very advantageous. The young trees that are to be removed yearly, will always find a ready market for a variety of purposes, unneceſsary here to enumerate. In addition to these advantages, if by this treatment of deep trenching previous to planting, and annual careful pruning during the growth, timber can be produced in about fifty years, of equal quality, and much superior in size, to that which has been above one hundred years growing under improper management, or without the aſsistance of cultivation: it will doubtleſs be allowed that a most beneficial, if not absolutely the best poſsible method of "raising Oaks," is here pointed out and ascertained.

This method of cultivation may perhaps be thought to occasion so much expense in manual labour as to prevent its being generally adopted: it might perhaps be sufficient to observe, that if the work be conducted with judgment and economy, the future produce would afford ample returns for all neceſsary expenditure: it should also be recollected,

that the previous preparation of the ground, and the subsequent pruning of the plants, are both to be performed at that season of the year when a scarcity of work will enable the planter to obtain assistance upon easier terms; with this additional advantage also, of providing employment for the labourer at those times when the general state of agricultural business renders it difficult for him to find maintenance for himself and family without charitable relief.

In 1750, at Ingestrie, in Staffordshire, the seat of Lord Chetwynd, some plantations were formed and managed in a great measure according to the principles here stated, and the growth of the plants was so uncommonly rapid, and so extraordinary, that it could not but attract the notice of all concerned in the conduct of them. The attention to the subject, then excited, has been the occasion and ground of all the observations and experiments made from that time to the present, the result of which is here given.

The extensive plantations of the late Lord Denbeigh, at Newnham Paddox, in Warwickshire, are well known and much admired.

The whole has been conducted with great judgment. About a square acre has been employed in raising Oaks upon a plan nearly similar to that now proposed, and affords the best and most convincing proof of the superior utility and efficacy of such management. Had the noble Earl been now living, I should have been enabled to have laid before the public some more detailed particulars: That, however, is not impofsible; this Efsay, therefore, in its present state may perhaps be thought not altogether unworthy of notice, as tending to forward and contribute, to the advantage of the public, the author conceiving that the best method of raising Oaks is ascertained and stated in it.

According to the statements made in this Efsay, and indeed from what may be seen in every part of the kingdom, in the character and appearance of Oaks growing without cultivation, it seems ascertained, that "acorns "set with the spade or dibble, without dig- "ging or tillage," can never be depended on to form good timber; and even in the most favourable circumstances of this case, the growth will be exceedingly slow and precarious. The same may be said of "young

"plants, previously raised in nurseries, and "transplanted;" for if the tap-root be cut, broken, or in any degree injured, which in transplanting it is almost impofsible to avoid, that plant will seldom become a vigorous and flourishing tree. The raising even one acre in the manner here ascertained, might be productive of great pecuniary advantage, if the facts and experience here detailed are permitted to prove the inutility of the other two methods, and consequently to remove the necefsity of employing so much ground upon them, at an expense they will never repay.

ESSAY XXVII.

On the Spanish Chesnut.

I AM of opinion, that, for hop-poles and stakes, the chesnut has no equal, in point of durability, and consequently no underwood can be applied to those purposes with equal profit. It is said that it is not so quick in its growth as ash; upon a moist soil, I think it is not, but upon a sand or loam, I apprehend it will

keep full pace with the ash, and attain sufficient size for hop-poles in fourteen years, and be worth at that age two guineas a hundred, and last, with proper care, twenty years; whilst ash, which seldon comes to sufficient size in leſs than twenty years, will only bear two-thirds of the price, and decay in half the time.

For gates and hurdles it is equally good, and being leſs heavy than oak, is another great recommendation to it, as it is removed from one place to another with greater ease. To these and many other purposes, chesnut, trained and cut as underwood, is peculiarly adapted; and, in point of beauty, no wood surpaſses it, as it admits of close planting, runs strait in its branches, and always appears florid and healthy.

I shall next consider the value of the Spanish chesnut for timber, in which (except for the unrivalled purposes of ship-building) it will be found for most uses equal to the oak, and in buildings and out-door work much superior.

In 1676, an ancestor of the present Mr. Windham, of Felbrigg, in Norfolk, had the

merit of being a considerable planter of chesnut. In the space of fifty years, it is presumed these plantations required thinning, as his succeſsor about that time began to apply this timber to useful purposes upon his estate.

The first account is of the branch or limb of a chesnut, about thirteen inches square, which, in the year 1726, was put down as a hanging post for a gate, and carried the gate without alteration, fifty-two years, when, upon altering the inclosures of the farm where it stood, it was taken up, under my direction, and appearing to be perfectly sound, was put down for a clapping-post in another place.

In 1743, a large barn was built with some of this timber, and is now as sound in every part, beams, principals, and spars, as when first the barn was built: about the same time, several chesnut posts and rails were put down, which I have since seen removed, and after standing thirty or forty years, generally appeared so sound, as to admit of being set up in some other place.

The last instance I shall mention, though not of long date, will show the great superi-

ority of this timber over oak in fences. In the year 1772, the present Mr. Windham made a large plantation in his park, which was fenced with posts and rails, converted from young oaks and chesnuts of the same age and scantling, such as were picked out of a place where they stood too thick. Last year, upon Mr. Windham's enlarging his plantation, it was neceſsary to remove this fence—when the chesnut posts were found as sound as when they were first put down, but those of the oak were so much wasted, just below the surface of the ground, that they could not be used for the same purposes again, without the aſsistance of a spur to support them.

ESSAY XXVIII.

On the Formation of Underwoods.

It is much to be lamented, that in the formation of Underwoods, so little attention seems to have been had to the sort of tree requisite for such purposes. Instead of the Spanish chesnut or ash, it is too common to see large tracts of wood land whose underwoods consist chiefly of hazel, hornbeam, and others of little use but for fuel; whereas the first-mentioned trees, besides being equally serviceable for that purpose with the latter, are greatly superior to them, as well as to most others in eſsential uses: so that, at the same time that the refuse of their growths might be consigned to the fire, the better parts might be destined to those purposes for which they are more particularly suited; and by such management a double advantage would arise.

Amidst a variety of subordinate uses to which, from my own observation, the Spanish chesnut seems adapted, are those of poles for

hops, and stakes for various purposes of husbandry. I have formed several plantations of this tree, with the view of treating it as underwood. The tree itself poſseſses a peculiar faculty of branching, provincially called *stubbing*, from the roots after being cut down, and this in a much greater degree than any of the useful forest-trees; so strong indeed is its propensity that way, that it is with some difficulty and attention that timber-trees of the chesnut are restrained from this redundancy of growth, which it is apprehended, by preventing part of the nutrition from ascending the stem, is apt to hinder their progreſs: but this quality, however inconvenient it may be in its effects to trees intended for the purposes of timber, is of eminent advantage to those designed for underwood; since, when the tree, after standing two or perhaps three years, to enable it to form a sufficient root, is cut down to a proper distance from the ground, it throws up in the following summer a profusion of strait shoots, which in due time become poles, such as for strength and durability exceed all others whatsoever, even those from the ash, which is generally considered as the best tree for this purpose.

Chesnut poles, it must be confeſsed, are slower in growth than those from the ash; but, on account of their greater durability, they are more profitable to the poſseſsor; and I have been credibly informed, that in some parts of Kent where this useful tree has been adapted to this purpose, its superiority to the ash is uncontroverted.

For the purposes of stakes for hedges, or other uses of that nature, its superiority seems equally established. I some time since formed a hedge, the stakes of which are wholly from chesnut-trees of my own planting: they are of such a degree of hardneſs, as to satisfy me, that the character given of its use for such purposes is by no means unfounded.

The plantations of this tree which I have formed, except that above-mentioned, are mostly cut down for underwood: the luxuriancy and quantity of shoots from the stubs afford me great satisfaction, and will, without doubt, answer my highest expectation.

ESSAY XXIX.

On Lime.

I KNOW nothing of more importance, less attended to by farmers in general, than the quality of lime. Not unfrequently in driving home, what they understand to be a thousand loads of lime, they are unknowingly bestowing their money, their time, and their labour, on a disguised substance, the half of which is sand or clay. This disguise too, can seldom be detected by the eye, or any of the other organs of perception. Plain directions therefore for discovering the qualities of lime, it is believed, may not be unworthy of notice.

Lime is an alkaline salt of such a nature, that if quite pure, it may be wholly dissolved in any strong acid or vinegar. It melts as completely away in this menstruum as common salt or sugar. Hence, it is very easy to try the comparative value of two or more pieces of limestone from different quarries. Buy a

bottle of muriatic acid, which may be obtained from any laboratory. Then weigh out equal quantities of the limestones, the comparative quality of which you mean to ascertain, mixing together a due proportion of the different seams or strata, that are commonly wrought in each quarry. That limestone which leaves least sediment when dissolved, is of course the best.

There can be no comparison made, however, if you take unburnt limestone of one rock, and burnt stones or slacked lime of another. Each portion for trial, must be precisely in the same state. For all pure unburnt limestones, contain about two-fifths or 40 per cent. of their weight of air (carbonic acid gas,) which is expelled by burning. Of consequence, a given weight of burnt limestone, must contain a proportion equal to this, of more refuse than the same weight of unburnt rock. Moreover, by the knowledge of the exact loss of weight occasioned by burning, a calculation may be made of the expediency of driving home limestone, to be burnt in some cases where the fuel is only to be got near home. In general, it is most profitable to carry off limestone as soon as burnt, in order to avoid weight of car-

riage, because, whenever it again grows cold, it begins to imbibe its carbonic acid from the atmosphere.

If lime is not pure, it is obvious that it will lose a great deal leſs weight in burning than pure lime. Hence arises another criterion for trying the goodneſs of lime. The lighter it is, for its bulk, or the more weight it loses in burning, the better. Weigh a piece of limestone, burn it properly, then weigh it again. If it has lost as much as two-fifths of its weight by burning, it is good lime.

Unburnt limestone seldom contains more than eighty per cent. of pure chalk or carbonate of lime. Pitleſsie quarry in Fife, belonging to Mr. Low of Annfield, has one stratum, containing 99½ per cent. of corbonate of lime, which is the purest limestone I have ever heard of. Perhaps, however, some fine marbles may be even more pure.

The colour of lime is no criterion of its goodneſs; for instance, Aberdour lime, which is blue, was found, on a comparative trial, to be richer than a quantity of Sunderland lime,

which was of a bright white colour, indicating purity in the general opinion.

Another method of trying the comparative goodneſs of lime, is by ascertaining what quantity of proper mortar fit for building (and which should fall readily off the mason's trowel) can be made from a given quantity of lime. As this may be done easily on a large scale, it is, in my humble apprehension, the best method of trial, because a large quantity of lime most generally contains a due mixture and proportion of all the different strata of the rock which are frequently exceedingly different in quality.

Some limes require no sand at all to make mortar for building; and these are esteemed by intelligent masons the best for architecture, as making the strongest cement. But such limestone, containing perhaps more than three-fourths of its bulk of sand, can seldom be applied with economy to the purposes of agriculture.

I was once present at a comparative trial by masons of two cargoes of lime, each of

which was accounted excellent. The one was from the neighbourhood of Aberdour, of a quarry belonging to the Earl of Morton, the other from a quarry in the vicinity of Edinburgh. The lime, of Aberdour, when slacked, produced three times their quantity of powdered lime; and that powdered lime required three times its quantity of clean sand to make good mortar for building. In other words, each boll of Aberdour lime, by being watered, became three bolls of quick lime powder, and each boll of the powder became good mortar with three bolls of sand. Thus each boll of these burnt limestones was converted into no lefs than nine bolls of building mortar, whereas each boll of the Edinburgh lime, slacked to two bolls of powder, and each of the bolls of powder required only two bolls of sand to make proper mortar. Thus the boll of Edinburgh-burnt limestone was convertible into no more than four times its quantity of mortar.

ESSAY XXX.

On House Lambs.

THE ewes are always, without exception, of the Dorsetshire breed, and even of these there are not more than one in three that will lamb sufficiently early for the purpose of house-lamb.

The early lambing ewes are sought for by the breeders of this county (Middlesex) with great diligence throughout the county of Dorset, and at the fairs where such stock are usually sold. The prices vary, from 35s. to 42s.

The sheep which begin to lamb about Michaelmas, are kept in the close during the day, and in the house during the night, until they have produced twenty or thirty lambs. These lambs are then put into a lamb-house, which is kept constantly well littered with clean wheat straw; and chalk, both in lump and in powder, is provided for them to lick, in order to prevent looseneſs, and thereby

preserve the lambs in health. As a prevention against gnawing the boards, or eating each other's wool, a little wheat-straw is placed, with the ears downwards, in a rack within their reach, with which they amuse themselves, and of which they eat a small quantity.

In this house they are kept, with great care and attention, until fit for the butcher.

The mothers of the lambs are turned, every night at eight o'clock, into the lamb-house to their offspring. At six o'clock in the morning these mothers are separated from their lambs, and turned into the pastures; and at eight o'clock, such ewes as have lost their own lambs, and those ewes whose lambs are sold, are brought in, and held by the head till the lambs by turns suck them clean; they are then turned into the pasture; and at twelve o'clock the mothers of the lambs are driven from the pasture into the lamb-house for an hour, in the course of which time each lamb is suckled by its mother. At four o'clock all the ewes that have not lambs of their own are again brought to the lamb-house, and held for the lambs to suck; and

at eight the mothers of the lambs are brought to them for the night.

If a ewe gives more milk than its lamb will suck, the superabundance is given to the twins, or to any other lamb whose mother may not be able to furnish it with sufficient food. The shepherd must in this case hold the ewe, or she would not suffer the strange lamb to suck. From their timid nature, it is extremely essential that they should be kept free from every species of unnecessary disturbance. This method of suckling is continued all the year. The breeders select such of the lambs as become fat enough, and of proper age (about eight weeks old) for slaughter, and send them to market during December, and three or four succeeding months, at prices which vary from one guinea to four, and the rest of the year at about two guineas each. This is severe work for the ewes, and some of them die under excess of exhaustion. However, care is taken that they have plenty of food; for when green food (viz. turnips, cole, rye, tares, clover, &c.) begins to fail, brewers' grains are given them in troughs, and second-crop hay in racks; as well to support the ewes, as to supply the

lambs with plenty of milk : for if that should not be abundant, the lambs would become stunted, in which case no food could fatten them.

The ewes should be kept free from the foot-rot and scab ; and if they have any pitch mark on them when they lamb, it must be cut off before the lambs be taken into the house, or they will eat it, and thereby greatly prejudice their future growth.

A lamb-house, to suckle from 160 to 180 lambs at a time, should be 70 feet long and 18 feet broad, with three coops of different sizes at each end, so constructed as to divide the lambs according to their ages.

The ewes, when separated from the lambs, ought to be so disposed as to enable the lambs to find their mothers without trouble ; and for this purpose deal hurdles are used, placed about the middle of the sheep-house.

Punctuality of time in letting the ewes in to the lambs, and keeping the lamb-house very cleanly littered, are very neceſsary precautions.

ESSAY XXXI.

On the Poor.

WITH a view to stop the increase of the poor rates, houses of industry have in many places been established; but they are grievous things in the eyes of the poor, and I am afraid, are not found to answer the end that was expected from them. I know of no law that can enforce industry; it may be encouraged, and great good will result from it; but it never can be effected by compulsion.

There are two principles which should be kept alive, as much as possible, in the minds of the poor—pride and shame: the former will lead them to the attainment of comfort by honest means; and the latter will keep them from becoming burdensome to their neighbours. But many of the modern plans, for making provisions for them, have tended to destroy these principles.

A man born to no inheritance, who assi-

duously devotes his whole life to labour, when nature declines, has as great a claim upon the neighbourhood, where the labour of his youth has been devoted, as the worn-out soldier or sailor has to Chelsea or Greenwich; and this reward ought to be as honourable, as it is comfortable, and not to be administered in a way that is repugnant to that natural love of rational freedom which every human mind sympathizes in the enjoyment of. Such a man, as I have here characterized, ought to be distinguished from the lazy and profligate wretch, who has seldom worked but by force. The one ought not to be crowded into the same habitation with the other; but in houses of industry there can be no distinction.

The social clubs for mutual relief, which are prevalent in many parts of England, are highly commendable; and, perhaps, as well worth the attention of the Board of Agriculture, as any object they can take up. If a little encouragement could be given to these laudable societies, which are now sanctioned by law, and proper places of security could be established for their little funds, it would tend very much to encourage the poor to struggle with their difficulties; and it would

be consistent with sound policy, as well as humanity, in the rich and opulent, to add little donations to the poor man's fund, on these occasions. Earl Harcourt's example, at Nuneham, in Oxfordshire, is well deserving imitation; if a poor man puts a penny into the social box, he puts in another; if a farmer or tradesman contributes a shilling, he adds another; and by this means his lordship's estate is kept in high credit, the poor-rates are low, and the spirit of the peasantry unbroken; which is the great thing that ought to be aimed at; and unleſs some encouragement of this sort be given, it is impoſsible that the labourer in husbandry can, when he has a family, procure his daily bread, with his present daily wages.

There is one thing which is incumbent on all great farmers to do, and that is, to provide comfortable cottages for two or three of their most industrious labourers, and to lay two or three acres of graſs land to each, to enable such labourer to keep a cow and a pig; such a man is always a faithful servant to the farmer who employs him: he has a stake in the common interest of the country, and is never prompt to riot, in times of sedition, like the

man who has nothing to lose; on the contrary, he is a strong link in the chain of national security.

There are but few great farmers, however, inclined to accommodate cottagers with these little portions of land, and when they do let them any, it is generally at double the rent they give for it. But I am persuaded, that if there were a certain number of cottages, of this description, in proportion to the size of the estates, and they were accommodated in this manner, and those places were bestowed as a reward to labourers of particular good conduct, it would do wonders towards the reduction of the rates, and the preservation of order; for I have been witneſs to several striking proofs of this, in two or three labourers, who have been thus favoured, whose attachment to their masters was exemplary, as they were not only steady in themselves, but by their example kept others from running into exceſs. There cannot well be too many of these places attached to large farms; they would be the most prolific cradles of the best sort of population.

There is another thing which it is incum-

bent on all occupiers of land to do, which is, to supply their own labourers with wheat at a moderate price—when the price in the market is high and oppreſsive to them. It is but reasonable, that the human servant should fare as well as the animal servant: a farmer does not give his horse a leſs quantity of oats, because they are dear, nor is it reasonable that the ploughman, or thrasher in his barn, should have leſs for his penny, because the master gets a great price; but I do not mean to say, this should be extended to manufacturers, because they are in general better paid than labourers in agriculture, and have not so immediate a claim upon the land, as the workmen in the vineyard.

ESSAY XXXII.

On the Education of the Poor.

THERE are some who allege that the education of the lower classes is not only useless, but hurtful; nay, some carry the matter so far, as to affirm, that it would be much better for society, if the greater part of them could neither write nor read. For, say they, that enlargement of mind which they thus acquire, is apt to render them self-conceited, and discontented with their lot; less tractable and submissive to their superiors; averse to the low and laborious, though necessary occupations of life; and ambitious of situations and employments to which they have no title to aspire.

This notion of public education, is so illiberal, so impolitic, and, in its consequences, so unjust, that I am confident few entertain it, and fewer still will be hardy enough to avow it. Indeed, it is so exceedingly absurd, that it scarcely deserves attention. Absurd as it

is, however, it may be improper, as it has been mentioned, to suffer it to pafs altogether unnoticed.

Have they, who embrace this wild opinion, I would ask, drawn the line between those clafses in society, who are to enjoy the privilege of education, and those who are not? Have they said how far down the scale of rank, knowledge may be allowed to descend, and where ignorance is to begin? They do not mean, surely, to exclude farmers, manufacturers, merchants, shopkeepers, tradesmen, and mechanics. Without reading, writing, and arithmetic, how could such people manage their affairs with any degree of order or exactnefs? How could they keep regular accounts, so neceſsary in businefs, or make out bills to their employers? Gentlemen would find it very inconvenient, I suppose, if their principal servants at least had no education. How unfit for their office would stewards, butlers, housekeepers, and principal farm-servants be, if they could neither read nor write? Even common labourers, and common servants, in this country, would often find a total ignorance of letters a great disadvantage. And is society at large to be de-

prived of a privilege which the great body of the people find so neceſsary in the common transactions of life, merely to obviate an ideal objection, which, had it any force, can apply only to the lowest and least numerous claſs?

Again, let me ask, is not Christianity the established religion of this country? Is it not the gift of Heaven to the poor as well as to the rich? Are not all, the servant as well as the master, the peasant as well as the peer, commanded to search the scriptures? And can any man, consistently with his character and profeſsion as a Christian, propose to withhold education from the lower ranks, and thereby render them incapable of reading their Bibles, and other books of religious and moral instruction, so neceſsary to their improvement in the knowledge of their duty, and their consolation under the toils and hardships of their humble lot?

Permit me to ask further, whether the system of those who hold the opinion in dispute, does not tear from the British Constitution one of its fairest ornaments, and destroy one of the strongest arguments, by which the attachment and veneration of the people can

be secured? Talents, abilities, and industry, are the chief distinctions which it profeſses to acknowledge. These it encourages and protects: and, poſſeſsed of these, the meanest and most obscure are permitted to rise to affluence, to honour, and to power. But how can any man avail himself of this constitutional advantage, if he is arrested at his outset by a regulation excluding him from the very first principles of literature?

I would ask, likewise, whether the dignity, strength, and general prosperity of any nation or state are not greatest, when genius, talents, and abilities, in whatever claſs or order of men in the community they may exist, are encouraged and permitted to exert themselves without check or control? And as these qualities do not belong exclusively to any particular rank, nor descend by inheritance in any particular line, is it not incumbent on those, who consult for the public interest, to adopt the most proper measures for the discovery and improvement of them? But can any scheme be devised, that will answer this end more effectually, than the establishment of parochial schools, suitably endowed, and under proper regulations? In these little seminaries of edu-

cation, while the children are instructed in the first principles of morals and literature, their young minds are opened; scope is given to their several powers and capacities to unfold themselves, and the strength and bent of every particular genius is, in some measure, discovered; by which means a right judgment may, in most cases, be formed of the particular department in life in which they will act with the greatest advantage; and consequently the subsequent plan of education most proper to be followed with that view, can with greater certainty be determined. The advantages, in this respect, of extending the means of education to every rank in society, are not merely fanciful and imaginary. They are known to be real, from fact and experience. How many men, descended from the lowest classes, have done honour to themselves, and signal service to their country, by the exertion of talents which, but for the little school of their native parish, would have remained for ever useless and unknown?

I have only to add, that the scheme of depriving the lower classes of the means of education, and thereby keeping them in gross ignorance, is inconsistent with the principles of

sound policy, and, if acted upon, might, in the present state of things, be productive of the most serious mischief to the State. In this idea I am supported by the sentiments of an eminent philosopher of the present age. Dr. Smith, in his celebrated Treatise on the Wealth of Nations, expresses himself, upon this subject, in the following words: "A man, without the proper use of the faculties of a man, is, if possible, more contemptible than even a coward; and seems to be mutilated and deformed in a still more essential part of the character of human nature. Though the State were to derive no advantage from the instruction of the inferior ranks of people, it would still deserve its attention that they should not be altogether uninstructed. The State, however, derives no inconsiderable advantage from their instruction. The more they are instructed, the less liable they are to the delusions of enthusiasm and superstition, which, among ignorant nations, frequently occasion the most dreadful disorders. And instructed and intelligent people, besides, are always more decent and orderly than an ignorant and stupid one. They feel themselves, each individually, more respectable, and more likely to

obtain the respect of their lawful superiors; and they are, therefore, more disposed to respect those superiors. They are more disposed to examine, and more capable of seeing through, the interested complaints of faction and sedition: and they are, upon that account, less apt to be misled into any wanton or unnecessary opposition to the measures of Government. In free countries, where the safety of Government depends very much upon the favourable judgment which the people may form of its conduct, it must surely be of the highest importance, that they should not be disposed to judge rashly or capriciously concerning it."

ESSAY XXXIII.

On Animal and Vegetable Life.

AMIDST the infinitely different productions which the earth offers, and with which it is every where covered, animals hold the first rank: as well because of the finer formation of their parts as of their superior power. The vegetable, which is fixed to one spot, and obliged to wait for its accidental supplies of nourishment, may be considered as the prisoner of nature. Unable to correct the disadvantages of its situation, or to shield itself from the dangers that surround it, every object that has motion may be its destroyer.

But, animals are endowed with powers of motion and defence. The greatest part are capable, by changing place, of commanding Nature; and of thus obliging her to furnish that nourishment which is most agreeable to their state. Those few that are fixed to one spot, even in this seemingly helpleſs situation,

are, nevertheleſs, protected from external injury, by a hard shelly covering, which they often can close at pleasure, and thus defend themselves from every aſsault. And here, I think, we may draw the line between the animal and vegetable kingdoms. Every animal, by some means or other, finds protection from injury; either from its force, or courage, its swiftneſs, or cunning. Some are protected by hiding in convenient places; and others by taking refuge in a hard resisting shell. But vegetables are totally unprotected; they are exposed to every aſsailant, and patiently submiſsive in every attack. In a word, an animal is an organized being that is in some measure provided for its own security; a vegetable is destitute of every protection.

But though it is very easy, without the help of definitions, to distinguish a plant from an animal, yet both poſseſs many properties so much alike, that the two kingdoms, as they are called, seemed mixed with each other. Hence, it frequently puzzles the naturalist to tell exactly where animal life begins, and vegetative terminates; nor, indeed, is it easy to resolve, whether some objects offered to view be of the lowest of the animal, or the highest of the

vegetable races. The sensitive plant, that moves at the touch, seems to have as much perception as the fresh water polypus, that is poſſeſsed of a still slower share of motion. Besides, the sensitive plant will not re-produce upon cutting in pieces, which the polypus is known to do; so that the vegetable production seems to have the superiority. But, notwithstanding this, the polypus hunts for its food, as most other animals do. It changes its situation, and therefore poſſeſses a power of choosing its food, or retreating from danger. Still, therefore, the animal kingdom is far removed above the vegetable; and its lowest denizen is poſſeſsed of very great privileges, when compared with the plants with which it is often surrounded.

However, both claſses have many resemblances, by which they are raised above the unorganized and inert maſses of nature. Minerals are mere inactive, insensible bodies, entirely motionleſs of themselves, and waiting some external force to alter their forms, or their properties. But it is otherwise with animals and vegetables; these are endued with life and vigour; they have their state of improvement and decay; they are capable of

reproducing their kinds; they grow from seeds, in some, and from cuttings in others; they seem all poſseſsed of sensation, in a greater or leſs degree; they both have their enmities and affections; and as some animals are, by nature, impelled to violence, so some plants are found to exterminate all others, and make a wilderneſs of the places round them. As the lion makes a desert of the forest where it resides, thus no other plant will grow under the shade of the machinel-tree. Thus, also, that plant, in the West Indies, called caraguata, clings round whatever tree it happens to approach; there it quickly gains the ascendant; and, loading the same with a verdure not its own, keeps away that nourishment designed to feed the trunk; and, at last, entirely destroys its supporter.

As all animals are ultimately supported upon vegetables, so vegetables are greatly propagated, by being made a part of animal food. Birds distribute the seeds wherever they fly, and quadrupeds prune them into greater luxuriance. By these means the quantity of food, in a state of nature, is kept equal to the number of the consumers; and, lest some of the weaker ranks of animals should find

nothing for their support, but all the provisions be devoured by the strong, different vegetables are appropriated to different appetites. If transgreſsing this rule, the stronger ranks should invade the rights of the weak, and, breaking through all regard to appetite, should make an indiscriminate use of every vegetable, nature then punishes the transgreſsion, and poison marks the crime as capital.

If again we compare vegetables and animals, with respect to the places where they are found, we shall find them bearing a still stronger similitude. The vegetables that grow in a dry and sunny soil, are strong and vigorous, though not luxuriant; so, also, are the animals of such a climate. Those, on the contrary, that are the joint product of heat and moisture, are luxuriant and tender: and the animals aſsimilating to the vegetable food, on which they ultimately subsist, are much larger in such places than in others. Thus, in the internal parts of South America, and Africa, where the sun usually scorches all above, while inundations cover all below, the insects, reptiles, and other animals, grow to a prodigious size. On the contrary, in the

cold frozen regions of the north, where vegetable nature is stinted of its growth, the few animals in those climates partake of the diminution; all the wild animals, except the bear, are much smaller than in milder countries; and such of the domestic kinds as are carried thither, quickly degenerate, and grow leſs. Their very insects are of the minute kinds, their bees and spiders being not half so large as those in the temperate zone.

The similitude between vegetables and animals is no where more obvious than in those that belong to the ocean, where the nature of one is admirably adapted to the neceſsities of the other. This element, it is well known, has its vegetables and its insects that feed upon them in great abundance. Over many tracts of the sea, a weed is seen floating, which covers the surface, and gives the resemblance of a green and extensive meadow. On the under side of these unstable plants, millions of little animals are found, adapted to their situation. For as their ground, if I may so expreſs it, lies over their heads, their feet are placed upon their backs; and as land animals have their legs below their bodies, these have them above.

Thus, in all places, we perceive an obvious similitude between the animals and the vegetables of every region. In general, however, the most perfect races have the least similitude to the vegetable productions on which they are ultimately fed; while, on the contrary, the meaner the animal, the more local it is found to be, and the more it is influenced by the varieties of the soil where it resides. Many of the more humble reptile kinds are not only confined to one country, but also to a plant; nay, even to a leaf. Upon that they subsist; increase with its vegetation, and seem to decay as it declines. They are merely the circumscribed inhabitants of a single vegetable; take them from that and they instantly die. For this reason there are infinite numbers of the meaner animals that we have never an opportunity of seeing in this part of the world; they are incapable of living separate from their kindred vegetables, which grow only in a certain climate.

Such animals as are formed more perfect, lead a life of less dependence; and some kinds are found to subsist in many parts of the world at the same time. But of all the races of Animated Nature, man is the least

affected by the soil where he resides, and least influenced by the variations of vegetable sustenance: equally unaffected by the luxuriance of the warm climates, or the sterility of the poles, he has spread his habitations over the whole earth; and finds subsistence as well amidst the ice of the north as the burning deserts under the line. All creatures of an inferior nature, as has been said, have peculiar propensities to peculiar climates; they are circumscribed to zones, and confined to territories where their proper food is found in the greatest abundance; but man may be called the animal of every climate, and suffers but very gradual alterations from the nature of any situation.

As to animals of a meaner rank, whom man compels to attend him in his migrations, these being obliged to live in a kind of constraint and upon vegetable food, often different from that of their native soil, they very soon alter their natures with the nature of their nourishment, assimilate to the vegetables upon which they are fed, and thus assume very different habits as well as appearances. Thus man, unaffected himself, alters and directs the nature of other animals at his pleasure;

increases their strength for his delight, or their patience for his neceſsities.

And this power of altering the appearances of things, seems to have been given him for very wise purposes. The Deity, when he made the earth, was willing to give his favoured creature many opponents, that might at once exercise his virtues, and call forth his latent abilities. Hence we find, in those wide uncultivated wilderneſses, where man, in his savage state, owns inferior strength, and the beasts claim divided dominion, that the whole forest swarms with noxious animals and vegetables; animals, as yet undescribed, and vegetables which want a name. In those receſses, Nature seems rather lavish than magnificent, in bestowing life. The trees are usually of the largest kinds, covered round with parasite plants, and interwoven at the tops with each other. The boughs, both above and below, are peopled with various generations; some of which have never been upon the ground, and others have never stirred from the branches on which they were produced. In this manner millions of minute and loathsome creatures pursue a round of uninterrupted existence, and enjoy a life

scarce superior to vegetation. At the same time, the vegetables, in those places, are of the larger kinds, while the animal race is of the smaller: but man has altered this disposition of Nature; having, in a great measure, levelled the extensive forests, cultivated the softer and finer vegetables, destroyed the numberleſs tribes of minute and noxious animals, and taken every method to increase a numerous breed of the larger kinds. He thus has exercised a severe control; unpeopled Nature, to embellish it; and diminished the size of the vegetable, in order to improve that of the animal kingdom.

To subdue the earth to his own use, was, and ought to be, the aim of man; which was only to be done by increasing the number of plants, and diminishing that of animals: to multiply existence, alone was that of the Deity. For this reason, we find, in a state of nature, that animal life is increased to the greatest quantity poſsible: and we can scarce form a system that could add to its numbers. First, plants, or trees, are provided by Nature of the largest kinds; and, consequently, the nourishing surface is thus extended. In the second place, there are animals peculiar to

every part of the vegetable, so that no part of it is lost. But the greatest posible increase of life would still be deficient, were there not other animals that lived upon animals themselves; and these are, themselves, in turn, food for some other greater and stronger set of creatures. Were all animals to live upon vegetables alone, thousands would be extinct that now have existence, as the quantity of their provision would shortly fail. But as things are wisely constituted, one animal now supports another; and thus all take up less room than they would by living on the same food; as, to make use of a familiar instance, a greater number of people may be crowded into the same space, if each is made to bear his fellow upon his shoulders.

To diminish the number of animals, and increase that of vegetables, has been the general scope of human industry; and if we compare the utility of the kinds, with respect to man, we shall find, that of the vast variety in the animal kingdom, but very few are serviceable to him; and in the vegetable, but very few are entirely noxious. How small a part of the insect tribes, for instance, are beneficial to mankind, and what numbers are

injurious! In some countries they almost darken the air: a candle cannot be lighted without their instantly flying upon it, and putting out the flame*. The closest receſſes are no safeguard from their annoyance; and the most beautiful landscapes of Nature only serve to invite their rapacity. As these are injurious, from their multitudes, so most of the larger kinds are equally dreadful to him, from their courage and ferocity. In the most uncultivated parts of the forest these maintain an undisputed empire; and man invades their retreats with terror. These are terrible; and there are still more that are utterly uſeleſs to him, that serve to take up that room which more benefical creatures might poſſeſs; and incommode him rather with their numbers than their enmities. Thus, in a catalogue of land animals, that amounts to more than twenty thousand, we can scarcely reckon up a hundred that are any way useful to him; the rest being either all his open, or his secret enemies, immediately attacking him in person, or intruding upon that food he has appropriated to himself. Vegetables, on the contrary, though existing in greater variety, are

* Ulloa's Description of Guayaquil.

but few of them noxious. The most deadly poisons are often of great use in medicine; and even those plants that only seem to cumber the ground, serve for food to that race of animals which he has taken into friendship, or protection. The smaller tribes of vegetables, in particular, are cultivated, as contributing either to his neceſsities, or amusement; so that vegetable life is as much promoted by human industry, as animal life is controlled and diminished.

Hence, it was not without a long struggle, and various combinations, of experience and art, that man acquired his present dominion. Almost every good that he poſseſses was the result of the contest; for every day as he was contending, he was growing more wise; and patience and fortitude were the fruits of his industry.

From hence, also, we see the neceſsity of some animals living upon each other, to fill up the plan of Providence; and we may, consequently, infer the expediency of man's living upon all. Both animals and vegetables seem equally fitted to his appetites; and, were any religious, or moral motives, to restrain

him from taking away life, upon any account, he would only thus give existence to a variety of beings made to prey upon each other; and, instead of preventing, he would only thus multiply mutual destruction.

ESSAY XXXIV.

On Planting Trees in Hedge-rows.

THE advocates for this practice say, that by planting hedge-rows of trees in the direction of the fence, the country is at once sheltered, beautified, and improved; and that the interest of the proprietor is ultimately promoted by the increasing value of the timber raised in these hedge-rows. It is also said, that such trees produce more branches for stack-wood, knees for ship-builders, and bark for the tanners; and they sell at a higher price per load than trees grown in woods and groves. Besides, close-pruning hedge-row trees, to the height of twelve or fifteen feet, prevents their damaging the hedge; the shelter which they afford is favourable to the vegetation both of

grafs and corn; it also tends to produce an equable temperature in the climate, which is favourable both to the production of greater perfection and beauty in animals, and of longevity to man.

When trees are planted in the line of a fence, if that fence is a hedge, the plants of which it consists, will not only be deprived of a great part of their nourishment by the trees, but will also be greatly injured by the shade they occasion, and the weight of the drop that falls from them during wet weather; upon this point little reasoning is neceſsary; for if we appeal to facts, we will find that no good hedge is to be met with, where there is a hedge-row of trees planted along with it.

The mischief is not, however, confined solely to hedges; the effects are equally bad, perhaps worse, where the fence is a stone wall; for though in this case the shade or drop of the trees are hardly, if at all, felt, yet when they have attained a certain height, the working and straining of the roots during high winds is such, that the foundations of the wall are shaken and destroyed: accordingly, wherever large trees are found growing near

stone walls, the fence is cracked and shaken by every gale of wind, is perpetually falling into large gaps, and costs ten times the expense to keep it in repair, that would otherwise be required if no trees were near it.

Admitting, however, that the trees in hedge-rows were no way prejudicial to the fence, which we have already shown is by no means the case, another argument may be successfully used against the practice. It is seldom, indeed, that trees planted in hedge-rows arrive at any great size; on the contrary, they are generally low and stunted; and while they occasion a visible loss by the mischief they do the fence, their utmost worth, when they come to be sold, will seldom be found adequate to the loss and inconvenience they have occasioned. This is very satisfactorily accounted for from the want of shelter; trees planted in hedge-rows being exposed to every inclement blast; by that means they are deprived of what is very essential to promote their growth, and which is in fact the cause why trees in large plantations thrive better than when they are planted singly; namely, the mutual shelter which they afford to each other; it being observed that all trees on the

skirts of plantations are much lower than those more removed from the extremity; this is owing to their bearing the first gust of the wind, which after being once broke, its violence is gradually abated, and in proportion as the trees recede from the verge of the plantations, they feel it less and rise higher.

Hedge-rows of trees are in a still more unprotected situation than those which form the skirts of a plantation, the latter being exposed to the violence of the wind only when it blows in one direction; this is what is generally termed the prevailing wind; when the gale is from any other quarter they can hardly be said to feel it; whereas, hedge-rows are exposed to the ravages of every blast, in whatever direction it may blow. There are, no doubt, some favoured spots where not only hedge-rows, but even single trees may thrive, and attain a great size, without any protection whatever; the cases in which this happens, are, however, but few, and can in no sense be quoted in support of the general practice of planting trees in hedge-rows.

It has often been hinted, and of late strongly insisted upon, though we think with infi-

nitely more zeal than judgment, that the sides of all the highways throughout the kingdom should be planted with hedge-rows of oaks. Very elaborate and highly-coloured statements have been given of the advantages that would result from the general introduction of this plan over the whole kingdom; but from much reflection, and a most attentive observation, we are enabled to state, that the supposed benefits held forth by the favourers of the system of planting the sides of the highways, in lieu of serving the public, would produce quite a contrary effect. The mischief occasioned by hedge-rows of trees upon the fences by way-sides, has already been mentioned, and those who have paid sufficient attention to the subject will bear testimony, that the roads are injured in a still greater degree. The circumstances neceſsary to form a proper road are, a good bottom, proper materials, and a sufficient declivity for carrying away the moisture, together with a complete exposure to the sun and air; where these are united, the road is good, and lasts for a considerable time; where any of them are wanting, the reverse is the case; for instance, though the bottom and materials are of the best kind, if the road is

shaded with trees, or tall hedges, and excluded from the benefit of the sun and wind, that road will always be a bad one, and scarce any exertion or expense will prevent it from being so; accordingly, throughout the whole kingdom, the worst roads are uniformly met with, in situations where belts of planting run parallel to them, or where very tall hedges grow on each side. The road contractors throughout the kingdom will, from dear-bought experience, corroborate this to their cost, as they uniformly find, that in every instance where the roads are bounded either by tall hedges, or belts of planting, the expense neceſsary to keep them in repair is more than doubled thereby, and the road, at the same time, worse than it is in situations where they are not shaded. This is remarkably the case, if the road runs in a direction from east to west: upon roads of that kind, if the south side is bounded either by a very tall hedge, or a hedge and row of trees, no pains or expense that can be bestowed, will be sufficient to keep it in good order. The great desideratum in road making is, that of forming the road in such a manner as to raise it sufficiently in the middle, and give it a gradual

slope to each side, to facilitate the descent of the moisture, and afterwards exposing it so completely to the action of the sun and air, as to dry it in the speediest manner after every shower.

It must be admitted, however, that in every situation, hedge-rows of trees, where they thrive, afford a degree of general shelter, and greatly improve the scenery; but these advantages are trivial when compared to their defects. The injury done every year both to the fences and highways throughout the kingdom, is apparent, and generally felt and complained of, both by farmers and road contractors.

ESSAY XXXV.

On the Size of Farms.

THE question respecting the size of farms has been much agitated. Some have argued that large farms are most favourable to population, and to the complete and rapid cultivation of the soil; whilst others have insisted that small farms are best calculated to produce these advantages. But as the arguments on both sides appear to be equally conclusive, it is presumable that both may be wrong. The truth is, the actual diversity of land, in respect of situation, quality, and state of improvement, naturally points out the propriety of a diversity in the size of farms. There is, no doubt, a point on both sides beyond which we ought not to go. No arable farm, perhaps, ought to exceed 400, or at the utmost 500 acres: and none should fall below 60 or 70 acres. Between these two points, farms may be of all different sizes, without prejudice to the public, or to the individual, varying, however, in this respect, according to existing

circumstances. If the ground be all arable, of a rich quality, and in a high state of cultivation, 60 or 70 acres may, in some cases, be sufficient, and may enable the occupant to rear his family, and to live in a decent, respectable style. But if the land be in a state of nature, or hath, as yet, received no substantial improvements, this size would be, by far, too small. No man of stock, enterprise, and ability, would sit down upon such a farm. He could have no room for exertion, no opportunity of a profitable application of his talents, and no prospect of receiving ultimately any returns corresponding to the capital and skill which he is able to employ. Farms, therefore, consisting of land of this kind, ought to be much more extensive. Three or four hundred acres might be sufficiently small. In like manner, ground that is not only arable, but, at the same time, best adapted to the cultivation of grain, may be let in much smaller proportions than would be proper in cases where the land is either not arable, or more applicable to the purposes of grazing and rearing cattle.

Besides, we find that there is a great diversity among men, in respect of abilities and

circumstances: it seems proper, therefore, that the division and size of farms should be proportioned, in a correspondence to this diversity. A man may be able to stock a farm of 80 or 100 acres, but not one of 300 or 400. Or, in point of ability, he may be equal to the task of managing the former, and yet not qualified to conduct the more extensive and complicated operations of the latter. On the other hand, it would be hard to confine a man of large stock, and superior abilities, to a small poſſeſſion, where he can have no scope for his genius, and where he cannot employ half his capital.

A mixture of large and small farms appears, in another point of view, to be extremely proper, as it may be the means of preventing a dangerous diminution of active and experienced hands for carrying on the operations of husbandry. Every gentleman-farmer has usually a foreman, to whom he commits the management of his farm: and almost every great farmer has one, either as a foreman or principal servant, on whose abilities and fidelity he can trust for conducting the practical part of his buſineſs. If this foreman be married, as is often the case, the prospect of

being able to secure a small farm for his son, if he has one, and to stock it, by the savings of his honest industry, will be a powerful inducement to breed him a farmer. Nor will this motive influence those merely who are already engaged in the farming line. The consideration of such a decent independence, so easily acceſsible, will induce others to breed their children to husbandry, by putting them into the service of the farmers; whilst the desire of attaining the object in view, as speedily, and with as much advantage as poſsible, will render such servants sober, industrious, and attentive to their duty.

Small farms thus paſsing into the hands of those who have acquired skill and experience on extensive farms under a proper system of husbandry, will form excellent nurseries for farm servants both to gentlemen and principal farmers. But should farms be generally of such magnitude as to preclude every hope of this kind, parents will seek independence for their children, by breeding them manufacturers, tradesmen, or mechanics.

In short, either extreme would be attended with bad consequences. On the one hand,

to mince down all the land in the kingdom into small tenements, whilst this could neither increase population nor add to the strength of the state, would, most probably, check the progress of improvement, and prevent its being ever brought to any degree of perfection. On the other hand, to throw the whole estates of the kingdom into the hands of a few great farmers, as it might be equally hurtful to the progress of agriculture, would certainly be highly impolitic, as it would weaken, in a considerable degree, that support and security which the constitution of the country, as well as public order and tranquillity, derive from the general diffusion of property. That *amor patriæ*, that public spirit, that strong sense of national honour, which, in former times, animated the breasts even of the lowest orders, seem now to be, in a great measure, gone, and nothing but the selfish principle remains, by which the great body of the people can be bound to their country and its support.

Let us suppose a large portion of this island, usually in the possession of husbandmen, thrown into the hands of 8000 great farmers; and each farmer to have one son who might be depended upon, as having a joint interest

with his father; there would, in this case, be only 16,000 of this clafs, whom we could trust to join the landholders in the defence of that part of the country: all the rest employed in husbandry being in a servile, dependent state, no certain or effectual support could be expected from them. Suppose again, that instead of 8000, the same extensive portion of land should be divided into 30,000 farms; in this case, we should have 60,000 men of this description, who, though not equally interested with those before mentioned, would, nevertheleſs, have such a stake, as would be a sufficient inducement to oppose every attempt against the peace and safety of the kingdom, whether from foreign or domestic foes.

Amongst the numerous causes which combined to overthrow the French monarchy, and to involve that nation in anarchy, despotism, and blood, this defect was, perhaps, one of the principal and most availing. All were either extremely rich, or miserably poor. In the hands of the higher orders, were all the honours, wealth, and power of the nation; while dependence, servility, and abject poverty, was the miserable portion of the lower, and

by far the most numerous clafs. And if there were any intermediate gradations, the numbers who occupied them were few; and the insecure and uncertain tenure by which they held their property, must have rendered their exertions feeble, even though they had been disposed to take part with their government. No wonder then, that men thus circumstanced, men who had nothing to lose, and no hopes of bettering their condition in the present state of things, should have been so easily deceived by the seeming patriotism of unprincipled demagogues, and so universally have fallen in with a scheme which promised them emancipation from poverty, dependence, and degradation, and a more equal distribution of property and power. And if we consider that turbulent and seditious temper, which, some years past, discovered itself in this country, and which required all the vigilance and activity of government to keep in check, it appears highly probable that, had it not been for the weight thrown into the scale of constitutional authority and power, by the numerous, wealthy, and respectable claſses which occupy the intermediate ranks between the great landholders, and those who have little or no property, revolutionary and anar-

chial principles might have prevailed, and this kingdom have experienced similar convulsions, attended with consequences equally disasterous and fatal.

ESSAY XXXVI.

On Leases.

THE ancient feudal tenures had undoubtedly a strong tendency to enslave mankind, by subjecting tenants to the control and power of an arbitrary lord; but, like all other things, there were some advantages to be found in the system. Every man, who held land, had a certainty in it, as the tenant generally held his poſseſsion for life. When these tenures were discountenanced, by the liberal spirit of modern law, some new compact became neceſsary, and terms of years were substituted in lieu of the former; for as land, properly managed, requires great expense, and seldom answers that expense in one year, it was but reasonable that the man who applied his

judgment, devoted his labour, and ventured his capital, should have some reasonable time allowed him to reimburse himself, and derive some proportionate reward for what he had done.

In the course of time, this term began to be reduced into a regular number of years. As most of the land was formerly under the regulation of two crops and a fallow, the time allowed was from three to twenty-one years, and the latter, in the end, became the most general limitation, and is the most prevalent term for leases at this time.

That leases are the first, the greatest, and most rational encouragement that can be given to agriculture, admits not of a doubt, in my opinion; but, of late years, there are very strong prejudices entertained against them. In the county of Norfolk, it is the custom to grant leases, which, in a great measure, accounts for the improvements that have taken place in it; most of the great estates have been made from it: for, without leases, no marling, to any extent, would have been undertaken, nor so much ground brought into cultivation, by one-third, as there now is.

The Holkham estate, alone, strongly proves this aſsertion, as it has been increased, in the memory of man, from five to upwards of twenty thousand pounds a year, and is still increasing like a snow-ball. Mr. Coke, the present owner of it, is a real friend to agriculture, and justly considered as one of the best landlords in that county. From my particular knowledge of him, I can say, that at least two years before his leases expire, he puts the tenant upon a footing of certainty, by stating to him, the terms he expects for a renewal of his lease, that he may have time to look out for another farm, in case he does not like the conditions that are offered to him; but, though the advance of rent is often very great, I have never seen an instance of any tenant leaving him, unleſs grown too far in years to be able to continue. The stipulations and reservations in his leases are founded, too, upon principles of equity, and consist in no unneceſsary repetition, or unreasonable exactions, being couched in plain terms, such as ought to compose a liberal contract between a gentleman and an industrious tenant; which may be worth imitation in thoſe who are found of crowding their leases with overbearing compulsatory clauses, tending more

to create obedience and servility in their tenants, than to promote good husbandry. There are some few estates, in Norfolk, of a very considerable size, where leases are entirely withheld; but it is evident, that these estates are obliged to be let for, at least, twenty per cent. leſs than what they would be, if leases were granted. In many other counties the prejudice is so strong, that an owner would almost as soon alienate the fee-simple of his estate, as demise it for a term of years. I will not be so harsh as to say, that this dislike to leases arises from obstinacy or want of sense, but it is certainly an unfortunate prejudice, which the proprietor takes up, and tends greatly to injure the public. One of the arguments made use of is, that it makes the tenant insolent and independent. There may be some few instances of this sort, but they ought not to be allowed to operate to the general injury of a country, however indifferent a gentleman may be to the advantage of his own purse. A man of large landed property owes, in my opinion, something to society, and ought to get rid of his prejudices, where they effect the community. Providence, who put him in poſseſsion of his property, undoubtedly meant that he should,

in some sort, act as a public steward, and it cannot be right that he should wrap up the talent entrusted to his care in a napkin. It grieves me to go into a country, which I often do, and find it almost in a state of nature, because, the soil being wet and expensive to cultivate, the tenant cannot afford to do it without encouragement, and the owner's insurmountable objection to leases, keeps him from granting the sort of encouragement which is eſsentially neceſsary. The yeomanry, in such parts, are upon a wretched, miserable footing; the public sustains a vast loſs; and the owner has, in lieu of the comfort he might bestow, and the good he might do, no other consolation than that he has the county more at command. But even this is a mistake; for I have, except in a few instances, always found a tenant as obliging and well behaved to his landlord, when he had a lease as when he had not.

The arguments in favour of leases seem to me so powerful, that I could not, on this occasion, suppreſs giving my full sentiments relating to them; and it seems unreasonable, to the greatest degree, to expect a tenant to hazard all he is worth, and devote the best

part of his life, upon an estate, which, upon the death, or perhaps the mere caprice, of his landlord, he is liable to be turned out of at six months notice. I will not, however, deny, that there may be some reasonable exceptions against the practice I wish to recommend, where lands lie near a gentleman's house, part of which it may be an object to take into hand; or, if a minor be very near of age, or if there be any immediate design of selling an estate, it is not prudent to grant leases, because, in the latter case, a purchaser may wish to enter into immediate poſseſsion, and may have particular objects in view, which will induce him to give a higher price than he would, under the idea of purchasing merely to pay him a reasonable interest. But, except in these instances, leases, in my opinion, cannot be too strongly recommended; for I am certain, that where estates are under an entail, or in a family that has no idea of parting with them, leasing is, unquestionably, the most effectual means of raising their value, as the owner, by this means, has it in his power to stipulate for improvements, in what manner and proportion he pleases, which he cannot do by any other means so well.

ESSAY XXXVII.

On Instinct.

INSTINCT is a propensity, prior to experience, and independent of instruction. We contend, that it is by instinct that the sexes of animals seek each other; that animals cherish their offspring; that the young quadruped is directed to the teat of its dam; that birds build their nests, and brood with so much patience upon their eggs; that insects which do not sit upon their eggs, deposit them in those particular situations, in which the young, when hatched, find their appropriate food; that it is instinct, which carries the salmon, and some other fish, out of the sea into rivers, for the purpose of shedding their spawn in fresh water.

We may select out of this catalogue the incubation of eggs. I entertain no doubt, but that a couple of sparrows hatched in an oven, and kept separate from the rest of their spe-

cies, would proceed as other sparrows do, in every office which related to the production and preservation of their brood. Aſsuming this fact, the thing is inexplicable upon any other hypothesis, than that of an instinct, impreſsed upon the constitution of the animal. For, first, what should induce the female bird to prepare a nest before she lays her eggs? It is in vain to suppose her to be poſseſsed of the faculty of reasoning; for no reasoning will reach the case. The fullneſs or distension which she might feel in a particular part of her body, from the growth and solidity of the egg within her, could not poſsibly inform her, that she was about to produce something, which, when produced, was to be preserved and taken care of. Prior to experience, there was nothing to lead to this inference, or to this suspicion. The analogy was all against it; for, in every other instance, what iſsued from the body was cast out and rejected.

But, secondly, let us suppose the egg to be produced into day: How should birds know that their eggs contain their young? there is nothing either in the aspect, or in the internal composition of an egg, which could lead even the most daring imagination to a conjecture,

that it was hereafter to turn out, from under its shell, a living perfect bird. The form of the egg bears not the rudiments of a resemblance to that of a bird. Inspecting its contents, we find still leſs reason, if poſsible, to look for the result which actually takes place. If we should go so far, as, from the appearance of order and distinction in the disposition of the liquid substances which we noticed in the egg, to gueſs that it might be designed for the abode and nutriment of an animal, (which would be a very bold hypothesis,) we should expect a tadpole dabbling in the slime, much rather than a dry, winged, feathered creature; a compound of parts and properties impoſsible to be used in a state of confinement in the egg, and bearing no conceivable relation, either in quality or material, to any thing observed in it. From the white of an egg, would any one look for the feather of a goldfinch? or expect from a simple uniform mucilage, the most complicated of all machines, the most diversified of all collections of substances? Nor would the proceſs of incubation, for some time at least, lead us to suspect the event. Who that saw red streaks, shooting in the fine membrane which divides the white from the yolk, would suppose that these were

about to become bones and limbs? who that espied two discoloured points first making their appearance in the cicatrix, would have had the courage to predict, that these points were to grow into the heart and head of a bird? it is difficult to strip the mind of its experience. It is difficult to resuscitate surprise, when familiarity has once laid the sentiment asleep. But could we forget all that we know, and which our sparrows never knew, about oviparous generation; could we divest ourselves of every information, but what we derived from reasoning upon the appearances or quality discovered in the objects presented to us, I am convinced that harlequin coming out of an egg upon the stage, is not more astonishing to a child, than the hatching of a chicken both would be, and ought to be, to a philosopher.

But admit the sparrow by some means to know, that within that egg was concealed the principle of a future bird, from what chymist was she to learn, that warmth was necefsary to bring it to maturity, or that the degree of warmth, imparted by the temperature of her own body, was the degree required?

To suppose, therefore, that the female bird acts in this proceſs from a ſagacity and reaſon of her own, is to ſuppoſe her to arrive at concluſions, which there are no premiſes to juſtify. If our ſparrow, ſitting upon her eggs, expect young ſparrows to come out of them, ſhe forms, I will venture to ſay, a wild and extravagant expectation, in oppoſition to preſent appearances, and to probability. She muſt have penetrated into the order of nature, further than any faculties of ours will carry us: and it hath been well obſerved, that this deep ſagacity, if it be ſagacity, ſubſiſts in conjunction with great ſtupidity, even in relation to the ſame ſubject. "A chymical operation," ſays Addiſon, "could not be followed with greater art or diligence, than is ſeen in hatching a chicken: yet is the proceſs carried on without the leaſt glimmering of thought or common ſenſe. The hen will miſtake a piece of chalk for an egg; is inſenſible of the increaſe or diminution of their number; does not diſtinguiſh between her own, and thoſe of another ſpecies; is frightened when her ſuppoſititious breed of ducklingstake the water."

But it will be ſaid, that what reaſon could

not do for the bird, observation, instruction, or tradition might. Now if it be true, that a couple of sparrows brought up from the first in a state of separation from all other birds, would build their nest, and brood upon their eggs, then there is an end of this solution. What can be the traditionary knowledge of a chicken hatched in an oven.

Of young birds taken in their nests, a few species breed, when kept in cages; and they which do so, build their nests nearly in the same manner as in the wild state, and sit upon their eggs. This is sufficient to prove an instinct, without having recourse to experiments upon birds, hatched by artificial heat, and deprived, from their birth, of all communication with their species: for we can hardly bring ourselves to believe, that the parent bird informed her unfledged pupil of the history of her gestation, her timely preparation of a nest, her exclusion of the eggs, her long incubation, and of the joyful eruption at last of her expected offspring; all which the bird in the cage must have learnt in her infancy, if we resolve her conduct into institution.

Unleſs we will rather suppose that she re-

members her own escape from the egg; had attentively observed the conformation of the nest in which she was nurtured; and had treasured up her remarks for future imitation. Which is not only extremely improbable, (for who that sees a brood of callow birds in their nest, can believe that they are taking a plan of their habitation?) but leaves unaccounted for, one principal part of the difficulty, "the preparation of the nest before the laying of the egg." This she could not gain from observation in her infancy.

It is remarkable also, that the hen sits upon eggs, which she has laid without any communication with the male; and which are therefore neceſsarily unfruitful. That secret she is not let into. Yet, if incubation had been a subject of instruction or of tradition, it should seem that this distinction would have formed part of the leſson: whereas the instinct of nature is calculated for a state of nature; the exception, here alluded to, taking place, chiefly, if not solely, amongst domesticated fowls, in which nature is forced out of her course.

There is another case of oviparous economy, which is still leſs likely to be the effect of

education, that it is even in birds, namely, that of moths and butterflies, which deposit their eggs in the precise substance, that of a cabbage for example, from which, not the butterfly herself, but the caterpillar which is to iſsue from her egg, draws its appropriate food. The butterfly cannot taste the cabbage. Cabbage is no food for her: yet in the cabbage, not by chance, but studiously and electively, she lays her egg. There are amongst many other kinds, the willow caterpillar, and the cabbage caterpillar; but we never find upon a willow, the caterpillar which eats the cabbage; nor the converse. This choice, as appears to me, cannot in the butterfly proceed from instruction. She had no teacher in her caterpillar state. She never knew her parent. I do not see, therefore, how knowledge acquired by experience, if it ever were such, could be transmitted from one generation to another. There is no opportunity either for instruction or imitation. The parent race is gone before the new brood is hatched. And if it be original reasoning in the butterfly, it is profound reasoning indeed. She must remember her caterpillar state, its tastes and habits; of which memory she shows no signs whatever. She must conclude from analogy,

for here her recollection cannot serve her, that the little round body, which drops from her abdomen, will at a future period produce a living creature, not like herself, but like the caterpillar which she remembers herself once to have been. Under the influence of these reflections she goes about to make provision for an order of things, which, she concludes, will, some time or other, take place. And it is to be observed, that not a few out of many, but that all butterflies argue thus; all draw this conclusion; all act upon it.

But suppose the addreſs, and the selection, and the plan, which we perceive in the preparations which many irrational animals make for their young, to be traced to some probable origin; still there is left to be accounted for, that which is the source and foundation of these phænomena, that which sets the whole at work, the στοργη parental affection, which I contend to be inexplicable upon any other hypothesis than that of instinct.

For we shall hardly, I imagine, in brutes, refer their conduct towards their offspring to a sense of duty, or of decency, a care of reputation, a compliance of public manners,

with public laws, or with rules of life built upon a long experience of their utility. And all attempts to account for the parental affection from asſociation, I think fail. With what is it aſsociated? Most immediately with the throes of parturition, that is, with pain and terror, and disease. The more remote, but not leſs strong aſsociation, that which depends upon analogy, is all against it. Every thing else, which proceeds from the body, is cast away and rejected.

In birds, is it the egg which the hen loves? or is it the expectation which she cherishes of a future progeny, that keeps her upon her nest? What cause has she to expect delight from her progeny? Can any rational answer be given to the question, why, prior to experience, the brooding hen should look for pleasure from her chickens? It does not, I think, appear, that the cuckoo ever knows her young: yet, in her way, she is as careful in making provision for them, as any other bird. She does not leave her egg in every hole.

The salmon suffers no surmountable obstacle to oppose her progreſs up the stream of fresh rivers. And what does she do there?

She sheds a spawn, which she immediately quits, in order to return to the sea; and this iſsue of her body she never afterwards recognizes in any shape whatever. Where shall we find a motive for her efforts, and her perseverance? Shall we seek it in argumentation, or in instinct? The violet crab of Jamaica performs a fatiguing march, of some months continuance, from the mountains to the sea-side. When she reaches the coast, she casts her spawn into the open sea; and sets out upon her return home.

Moths and butterflies, as hath already been observed, seek out for their eggs, those precise situations and substances, in which the offspring caterpillar will find its appropriate food. That dear caterpillar the parent butterfly must never see. There are no experiments to prove that she would retain any knowledge of it, if she did. How shall we account for her conduct? I do not mean for her art and judgment in selecting and securing a maintenance for her young, but for the impulse upon which she acts. What should induce her to exert any art, or judgment, or choice, about the matter? The undisclosed grub, the animal, which she is destined not to know, can

hardly be the object of a particular affection, if we deny the influence of instinct. There is nothing, therefore, left to her, but that, of which her nature seems incapable, an abstract anxiety for the general preservation of the species; a kind of patriotism; a solicitude lest the butterfly race should cease from the creation.

Lastly; the principle of afsociation will not explain the discontinuance of the affection when the young animal is grown up. Afsociation, operating in its usual way, would rather produce a contrary effect. The object would become more neceſsary by habits of society: whereas birds and beasts, after a certain time, banish their offspring; disown their acquaintance; seem to have even no knowledge of the objects which so lately engroſsed the attention of their minds, and occupied the industry and labour of their bodies. This change, in different animals, takes place at different distances of time from the birth; but the time always corresponds with the ability of the young animal to maintain itself: never anticipates it. In the sparrow tribe, when it is perceived that the young brood can fly and shift for themselves, then the parents forsake

them for ever; and, though they continue to live together, pay them no more attention than they do to other birds in the same flock *. I believe the same thing is true of all gregarious quadrupeds.

In this part of the case the variety of resources, expedients, and materials, which animals of the same species are said to have recourse to, under different circumstances, and when differently supplied, makes nothing against the doctrine of instincts. The thing which we want to account for is the propensity. The propensity being there, it is probable enough that it may put the animal upon different actions according to different exigences. And this adaptation of resources may look like the effect of art and consideration, rather than of instinct; but still the propensity is instinctive. For instance, suppose what is related of the woodpecker to be true, that, in Europe, she deposits her eggs in cavities, which she scoops out in the trunks of soft or decayed trees, and in which cavities the eggs lie concealed from the eye, and in

* Goldsmith's Nat. Hist. vol. iv. p. 244.

some sort safe from the hand of man; but that, in the forests of Guinea and the Brasils, which man seldom frequents, the same bird hangs her nest to the twigs of tall trees; thereby placing them out of the reach of monkeys and snakes, i. e. that in each situation she prepares against the danger which she has most occasion to apprehend: suppose, I say, this to be true, and to be alleged, on the part of the bird that builds these nests, as evidence of a reasoning and distinguishing precaution, still the question returns, whence the propensity to build at all?

Nor does parental affection accompany generation by any universal law of animal organization, if such a thing were intelligible. Some animals cherish their progeny with the most ardent fondneſs, and the most aſsiduous attention; others entirely neglect them: and this distinction always meets the constitution of the young animal, with respect to its wants and capacities. In many, the parental care extends to the young animal; in others, as in all oviparous fish, it is confined to the egg, and even, as to that, to the disposal of it in its proper element. Also, as there is generation without parental affection, so is there

parental instinct, or what exactly resembles it, without generation. In the bee tribe, the grub is nurtured neither by the father nor the mother, but by the neutral bee. Probably the case is the same with ants.

I am not ignorant of the theory, which resolves instinct into sensation; which aſserts, that what appears to have a view and relation to the future, is the result only of the present disposition of the animal's body, and of pleasure or pain experienced at the time. Thus the incubation of eggs is accounted for by the pleasure which the bird is supposed to receive from the preſsure of the smooth convex surface of the shells against the abdomen, or by the relief which the mild temperature of the egg may afford to the heat of the lower part of the body, which is observed at this time to be increased beyond its usual state. This present gratification is the only motive with the hen for sitting upon her nest: the hatching of the chickens is, with respect to her, an accidental consequence. The affection of viviparous animals for their young, is in like manner solved by the relief, and perhaps the pleasure, which they perceive from giving suck. The young animal's seeking,

in so many instances, the teat of its dam, is explained from the sense of smell, which is attracted by the odour of the milk. The salmon's urging its way up the stream of fresh water rivers, is attributed to some gratification or refreshment, which, in this particular state of the fish's body, she receives from the change of element. Now of this theory it may be said:

First, that of the cases which require solution, there are few, to which it can be applied with tolerable probability;—that there are none, to which it can be applied without strong objections, furnished by the circumstances of the case. The attention of the cow to its calf, and of the ewe to its lamb, appear to be prior to their sucking. The attraction of the calf or lamb to the teat of the dam is not explained by simply referring it to the sense of smell. What made the scent of the milk so agreeable to the lamb that it should follow it up with its nose, or seek with its mouth the place from which it proceeded? No observation, no experience, no argument could teach the new-dropped animal, that the substance, from which the scent issued, was the material of its food. It had never

tasted milk before its birth. None of the animals, which are not designed for that nourishment, ever offer to suck, or to seek out any such food. What is the conclusion, but that the sugescent parts of animals are fitted for their use, and the knowledge of that use put into them?

We assert, secondly, that, even as to the cases in which the hypothesis has the fairest claim to consideration, it does not at all lessen the force of the argument for intention and design. The doctrine of instincts, is that of *appetencies*, superadded to the constitution of an animal, for the effectuating of a purpose beneficial to the species. The above stated solution would derive these appetencies from organization; but then this organization is not less specifically, not less precisely, and therefore not less evidently adapted to the same ends, than the appetencies themselves would be upon the old hypothesis. In this way of considering the subject, sensation supplies the place of foresight: but this is the effect of contrivance on the part of the Creator. Let it be allowed, for example, that the hen is induced to brood upon her eggs by the enjoyment or relief, which, in the heated state of

her abdomen, she experiences from the pressure of round smooth surfaces, or from the application of a temperate warmth. How comes this extraordinary heat or itching, or call it what you will, which you suppose to be the cause of the bird's inclination, to be felt, just at the time when the inclination itself is wanted; when it tallies so exactly with the internal constitution of the egg, and with the help which that constitution requires in order to bring it to maturity? In my opinion, this solution, if it be accepted as to the fact, ought to increase, rather than otherwise, our admiration of the contrivance. A gardener lighting up his stoves, just when he wants to force his fruit, and when his trees require the heat, gives not a more certain evidence of design. So again; when a male and female sparrow come together, they do not meet to confer upon the expediency of perpetuating their species. As an abstract proposition, they care not the value of a barley-corn whether the species be perpetuated, or not. They follow their sensations; and all those consequences ensue, which the wisest counsels could have dictated, which the most solicitous care of futurity, which the most anxious concern for the sparrow world, could have pro-

duced. But how do these consequences ensue? The sensations, and the constitution upon which they depend, are as manifestly directed to the purpose which we see fulfilled by them; and the train of intermediate effects, as manifestly laid and planned with a view to that purpose, that is to say, design is as completely evinced by the phænomena, as it would be, even if we suppose the operations to begin, or to be carried on, from what some will allow to be alone properly called instincts, that is, from desires directed to a future end, and having no accomplishment or gratification distinct from the attainment of that end.

In a word; I should say to the patrons of this opinion, be it so: be it, that those actions of animals which we refer to instinct, are not gone about with any view to their consequences, but that they are attended in the animal with a present gratification, and are pursued for the sake of that gratification alone; what does all this prove, but that the prospection, which must be somewhere, is not in the animal, but in the Creator?

In treating of the parental affection in brutes, our business lies rather with the origin of the principle, than with the effects and expressions of it. Writers recount these with pleasure and admiration. The conduct of many kinds of animals towards their young, has escaped no observer, no historian, of nature. "How will they cares them," says Derham, "with their affectionate notes; lull and quiet them with their tender parental voice; put food into their mouths; cherish, and keep them warm; teach them to pick, and eat, and gather food for themselves; and, in a word, perform the part of so many nurses, deputed by the sovereign Lord and preserver of the world, to help such young and shiftless creatures?" Neither ought it, under this head, to be forgotten, how much the instinct costs the animal which feels it; how much a bird, for example, gives up, by sitting upon her nest; how repugnant it is to her organization, her habits, and her pleasures. An animal, formed for liberty, submits to confinement, in the very season when every thing invites her abroad: what is more; an animal delighting in motion, made for motion, all whose motions are so easy and so free, hardly a moment, at other

times, at rest, is, for many hours of many days together, fixed to her nest, as close as if her limbs were tied down by pins and wires. For my part, I never see a bird in that situation, but I recognise an invisible hand, detaining the contented prisoner from her fields and groves, for a purpose, as the event proves, the most worthy of the sacrifice, the most important, the most beneficial.

But the loſs of liberty is not the whole of what the procreant bird suffers. Harvey tells us, that he has often found the female wasted to skin and bone by sitting upon her eggs.

One observation more. The pairing of birds, and the non-pairing of beasts forms a distinction between the two claſses, which shows, that the conjugal instinct is modified with a reference to utility founded in the condition of the offspring. In quadrupeds, the young animal draws its nutriment from the body of the dam. The male parent neither does, nor can, contribute any part to its sustentation. In the feathered race, the young bird is supplied by an importation of food, to procure and bring home which, in a sufficient quantity for the demand of a numerous

brood, requires the industry of both parents. In this difference we see a reason, for the vagrant instinct of the quadruped, and for the faithful love of the feathered mate.

ESSAY XXXVIII.

On the Rationale of Mowing and Pasturage.

BROAD clover, and many other succulent plants, are with some difficulty made into hay; and, in all probability, may be consumed much more profitably as a green than as a dry fodder; because, as soon as they are cut, the plants quickly vegetate afresh during the summer-season; and, by being repeatedly cut, produce a much greater weight of forage than if they had been allowed to bring their seeds to maturity. For it is observable of almost all these succulent plants, that they push out very vigorous shoots soon after they are cut, which advance with great rapidity until the plant hath attained nearly its full stature; after which period it advances more slowly, till it at length becomes entirely

stationary, and is solely employed about the formation of its seeds. Now, if the plant be always cut when it approaches towards that stationary state, it will be always kept in the state of vigorous vegetation; and thus it would seem that a much greater quantity of vegetable matter would be produced, than if it were allowed to arrive at greater maturity before each cutting.

This is still more apparent with regard to lucern than broad clover. This plant, if allowed to come to its full size, will, in a good soil, attain the height of four feet, or a little more, in one season. But I myself have cut a plant of lucern six times in one season, allowing it to be about twenty inches high before each cutting; which gives upwards of ten feet for the growth of one year;—considerably more than double the height that it would have reached if it had not been cut at all. And although it be acknowledged, that the more succulent shoots, obtained in consequence of frequent cutting, would not contain such a quantity of solid matter as an equal weight of the better maturated stalks would have done; yet it does not seem at all probable, that the deficiency arising from this

cause would nearly counterbalance the surplus quantity obtained by frequent cutting. Besides, the number of stalks is augmented by cutting, so that it not only advances more in length, but in thickneſs also. This is an object, among many others, that cannot be determined exactly without accurate experiments.

On the other hand, it would seem probable, that some of the culmiferous plants or graſses *(gramina)* properly so called, being leſs capable of recovering themselves after being cut, when the stalks have been allowed to advance to any considerable length, (as is evidently the case with regard to common rye-graſs) [*Lolium Perenne*] would afford but poor returns if cut green, although they may yield a very weighty crop of hay if suffered to attain a proper degree of maturity. But however great the probability is that this may be the case, still it is no more than a probability. Nor can the farmer hope to arrive at certainty in this case, till he knows, by accurate experiment, not only the exact qualities of each of these plants when green or dry, but also the quantity of each that can be produced upon the same soil with equally skilful management.

Some plants that may be equally nourishing to animals, and that equally require to be consumed green, may nevertheleſs differ in this respect, that one claſs may be more economically consumed by having the plants cut, and given by hand in that state to the animals that feed upon them, while another claſs may be more profitably consumed by being depastured by animals.

It will be in general allowed, that the two plants mentioned above, broad clover and lucern, are more advantageously consumed when cut and given green by the hand, than when pastured upon. Probably this may likewise be, in some measure, the case with all quick-shooting strong-stemmed plants, that do not grow close enough at the root to form a firm bottom for animals to bite upon. It is likewise probable, that, in general, such close-growing leafy graſses as require to be consumed green, and other weak succulent trailing plants, which run along the ground, and form a thick sward there, but do not rise quickly to a great height, so as to admit of being readily cut by the scythe, would be more profitable for pasturage. But, here again, we are in the region of proba-

bility; nor do we as yet know, with any degree of certainty, either the different plants reducible to each of these classes, or the several limitations that in particular circumstances might take place with regard to any of these.

On this subject it may not be improper to take notice of a circumstance that ought not by any means to be overlooked by those who are obliged to supply the want of accurate experiments, by probable reasoning from detached facts that accidentally occur. It is this: by accurate observations, any one may soon be satisfied, that if the flower-stalks of the greater part of culmiferous grasses are destroyed after they are fully formed, the plants do not attempt to form other flower-stalks that season, but run afterwards chiefly to leaves, and spread by their roots. Now, if in this state these plants are allowed to remain for any considerable length of time, without being either pastured upon or cut, the leaves gradually stop from growing,—remain after that for some time stationary, and then fade away, if they are not so luxuriant as to rot; and in this way, the whole produce of a field may frequently amount to no more than a

few inches in length in a season. But if these leaves had been cut, or had the field at different times been pastured upon, the vegetation would at each time have been renewed, and it would have produced perhaps five or six times more than if this repeated cropping had been omitted.

This I once had an opportunity of being satisfied of experimentally, with regard to two plants of sheep's fescue-grafs [*Festuca Ovina*], which grew upon the same soil, and were in equal health, and in every other respect alike when the experiment was tried. The leaves of each of these two plants, before the end of May, or beginning of June, had advanced to about six inches in length, and after that remained quite stationary for some weeks:—Observing which, I cut off, with a sharp knife, all the leaves of one of the plants quite close by the ground; and in a very few days it pushed out a set of fresh leaves with great vigour. These were cut three or four several times during the remaining part of the season, when about the height of three inches at each time; although it was not pofsible to remark the smallest increase of one blade upon the other plant during all that time.

From this experiment, it would seem that we might fairly draw the following obvious corollary, viz. That if grafs, in these circumstances, is to be consumed either by pasturing or cutting, it is the greatest want of economy to allow it to remain long between each of these operations; and if we mean to reap the full profit from the field, the oftener these cuttings are repeated, after the grafs is of a sufficient length for a bite to the animals which may pasture upon it, or for the scythe to strike it, so much the better.

From this experiment, we may farther infer, that it will be in general perhaps more for the advantage of the farmer, to consume grafses of this sort by pasturage than by cutting; for, as these grafses are always much closer at the roots than the top, when we attempt to cut them by the scythe, unlefs the field is as smooth as a bowling-green, a great deal of the closest of the pile will escape the edge of the scythe and be lost. And if these cuttings are frequently repeated, the proportion that this under-stubble will bear to that which is above the scythe, must be at each cutting very considerable. And as the stems, when cut, do not for the most part continue to ad-

vance afterwards, but die, and are succeeded by fresh shoots that spring up from the roots, all of these stubbles are entirely lost; which, in these circumstances, might perhaps amount nearly to one-half of the whole produce of the field; a great part of which would, perhaps, have been saved, if the field had been judiciously pastured upon. But if it can be kept firm on the surface, and smooth as a bowling-green, so as to suffer the scythe to cut close, perhaps more benefit would be derived from cutting than pasturage, as no parts of the field could escape the scythe, though it is well known that no art can make animals eat down the grafs of a field quite equally, if it be not greatly overstocked.

ESSAY XXXIX.

On a submarine Forest, on the east coast of England.

In geology, more perhaps than in any other branch of natural history, there exists a neceſsity of strictly separating the facts observed from the ideas which, in order to explain them, may occur to the mind of the observer. In the present state of this science, every well ascertained fact increases our still narrow stock of real knowledge; when, on the contrary, the reasonings we are enabled to make, are at best but ingenious gueſses, which too often bias and mislead the judgment. I shall therefore endeavour, in this Eſsay, to give first a mere description of the object, unmixed with any systematical ideas, and shall afterwards offer such conjectures on its cause as seem to me to be fairly grounded on observation.

It was a common report in Lincolnshire, that a large extent of islets of moor, situated along its coast, and visible only in the lowest

ebbs of the year, was chiefly composed of decayed trees. These islets are marked in Mitchell's chart of that coast, by the name of *clay huts;* and the village of Huttoft, opposite to which they principally lie, seems to have derived its name from them. In the month of September, 1796, I went to Sutton, on the coast of Lincolnshire, in company with the Right Hon. Sir Joseph Banks, in order to examine their extent and nature. The 19th of the month, being the first day after the equinoctial full moon, when the lowest ebbs were to be expected, we went in a boat, at half past twelve at noon, and soon after set foot upon one of the largest islets then appearing. Its exposed surface was about thirty yards long, and twenty-five wide, when the tide was at the lowest. A great number of similar islets were visible round us, chiefly to the eastward and southward; and the fishermen, whose authority on this point is very competent, say, that similar moors are to be found along the whole coast, from Skegnefs to Grimsby, particularly off Addlethorpe and Mablethorpe. The channels dividing the islets were, at the time we saw them, wide, and of various depths; the islets themselves ranging generally from east to west in their largest dimension.

We visited them again in the ebbs of the 20th and 21st; and though it generally did not ebb so far as we expected, we could notwithstanding ascertain, that they consisted almost entirely of roots, trunks, branches, and leaves of trees and shrubs, intermixed with some leaves of aquatic plants. The remains of some of these trees were still standing on their roots; while the trunks of the greater part lay scattered on the ground, in every pofsible direction. The bark of the trees and roots appeared generally as fresh as when they were growing; in that of the birches particularly, of which a great quantity was found, even the thin silvery membranes of the outer skin were discernible. The timber of all kinds, on the contrary, was decomposed and soft, in the greatest part of the trees; in some, however, it was firm, especially in the knots. The people of the country have often found among them very sound pieces of timber, fit to be employed for several economical purposes.

The sorts of wood which are still distinguishable are birch, fir, and oak. Other woods evidently exist in these islets, of some of which we found the leaves in the soil; but

our present knowledge of the comparative anatomy of timbers, is not so far advanced as to afford us the means of pronouncing with confidence respecting their species. In general, the trunks, branches, and roots of the decayed trees, were considerably flattened; which is a phænomenon observed in the *Surtarbrand* or fosil wood of Iceland, and which Scheuchzer remarked also in the fosil wood found in the neighbourhood of the lake of Thun, in Switzerland.

The soil to which the trees are affixed, and in which they grew, is a soft greasy clay; but, for many inches above its surface, the soil is entirely composed of rotten leaves, scarcely distinguishable to the eye, many of which may be separated, by putting the soil in water, and dexterously and patiently using a spatula, or a blunt knife. By this method, I obtained some perfect leaves of *Ilex Aquifolium,* which are now in the Herbarium of the Right Hon. Sir Joseph Banks; and some other leaves which, though less perfect, seem to belong to some species of willow. In this stratum of rotten leaves, we could also distinguish several roots of *Arundo Phragmites.*

These islets, according to the most accurate information, extend at least twelve miles in length, and about a mile in breadth, opposite to Sutton shore. The water without them, towards the sea, generally deepens suddenly, so as to form a steep bank. The channels between the several islets, when the islets are dry, in the lowest ebbs of the year, are from four to twelve feet deep; their bottoms are clay or sand, and their direction is generally from east to west.

A well dug at Sutton, by Joshua Searby, shows that a moor of the same nature is found under ground, in that part of the country, at the depth of sixteen feet; consequently, very nearly on the same level with that which constitutes the islets. The disposition of the strata was found to be as follows:

Clay,	16 feet.
Moor, similar to that of the islets,	from 3 to 4 ditto.
Soft moor, like the scowerings of a ditch bottom, mixed with shells and silt,	20 ditto.
Marly clay,	1 foot.
Chalk rock,	from 1 to 2 feet.
Clay,	31 yards.
Gravel and water; the water has a chalybeate taste.	

In order to ascertain the course of this subterraneous stratum of decayed vegetables, Sir Joseph Banks directed a boring to be made in the fields belonging to the Royal Society, in the parish of Mablethorpe. Moor, of a similar nature to that of Searby's well, and of the islets, was found, very nearly on the same level, about four feet thick, and under it a soft clay.

The whole appearance of the rotten vegetables we observed, perfectly resembles, according to the remark of Sir Joseph Banks, the moor which, in Blankeney fen, and in other parts of the East fen in Lincolnshire, is thrown up in the making of banks; barks, like those of the birch tree, being there also abundantly found. This moor extends over all the Lincolnshire fens, and has been traced as far as Peterborough, more than sixty miles to the south of Sutton. On the north-side, the moory islets, according to the fishermen, extend as far as Grimsby, situated on the south-side of the mouth of the Humber; and it is a remarkable circumstance, that in the large tracts of low lands which lie on the south banks of that river, a little above its mouth, there is a subterraneous stratum of de-

cayed trees and shrubs, exactly like those we observed at Sutton; particularly at Axholme isle, a tract of ten miles in length, by five in breadth; and at Hatfield Chase, which comprehends one hundred and eighty thousand acres. Dugdale* had long ago made this observation, in the first of these places; and De la Pryme† in the second. The roots are there likewise standing in the places where they grew; the trunks lie prostrate. The woods are of the same species as at Sutton. Roots of aquatic plants and reeds are likewise mixed with them; and they are covered by a stratum of some yards of soil, the thickneſs of which, though not ascertained with exactneſs by the above-mentioned observers, we may easily conceive to correspond with that which covers the stratum of decayed wood at Sutton, by the circumstance of the roots being (according to Mr. Richardson's observations‡) only visible when the water is low, where a channel was cut, which has left them uncovered.

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* History of Embanking and Draining. Chap. xxvii.

† Philos. Trans. Vol XXII. p. 980.

‡ Philos. Trans. Vol. XIX. p. 528.

Little doubt can be entertained of the moory islets of Sutton being a part of this extensive subterraneous stratum, which, by some inroad of the sea, has been there stripped of its covering of soil. The identity of the levels; that of the species of trees; the roots of these affixed, in both, to the soil where they grew: and, above all, the flattened shape of the trunks, branches, and roots, found in the islets, (which can only be accounted for by the heavy pressure of a superinduced stratum,) are sufficient reasons for this opinion.

Such a wide spread aſsemblage of vegetable ruins, lying almost in the same level, and that level generally under the common mark of low water, must naturally strike the observer, and give birth to the following questions.

1. What is the epoch of this destruction?

2. By what agency was it effected?

In answer to these questions, I will venture to submit the following reflections.

The foſsil remains of vegetables hitherto

dug up in so many parts of the globe, are, on a close inspection, found to belong to two very different states of our planet. The parts of vegetables, and their impreſsions, found in mountains of a cotaceous, schistous, or even sometimes of a calcareous nature, are chiefly of plants now existing between the tropics, which could neither have grown in the latitudes in which they are dug up, nor have been carrried and deposited there by any of the acting forces under the present constitution of nature. The formation, indeed, of the very mountains in which they are buried, and the nature and disposition of the materials which compose them, are such as we cannot account for by any of the actions and re-actions which, in the actual state of things, take place on the surface of the earth. We must neceſsarily recur to that period in the history of our planet, when the surface of the ocean was at least so much above its present level, as to cover even the summits of these secondary mountains which contain the remains of tropical plants. The changes which these vegetables have suffered in their substance, is almost total; they commonly retain only the external configuration of what they originally were. Such is the state in

which they have been found in England, by Llwyd; in France, by Juſsieu; in the Netherlands, by Burtin; not to mention instances in more distant countries. Some of the impreſsions or remains of plants found in ſoils of this nature, which were, by more ancient and leſs enlightened oryctologists, ſuppoſed to belong to plants actually growing in temperate and cold climates, ſeem, on accurate investigation, to have been parts of exotic vegetables. In fact, whether we ſuppoſe them to have grown near the ſpot where they are found, or to have been carried thither from different parts, by the force of an impelling flood, it is equally difficult to conceive, how organized beings, which, in order to live, require ſuch a vaſt difference in temperature and in ſeaſons, could live on the ſame ſpot, or how their remains could (from climates ſo widely diſtant) be brought together to the ſame place, by one common diſlocating cauſe. To this ancient order of foſsil vegetables belong whatever retains a vegetable ſhape, found in or near coal mines, and (to judge from the places where they have been found) the greater part of the agatized woods. But from the ſpecies and preſent ſtate of the trees which are the ſubject of this memoir, and from the

situation and nature of the soil in which they are found, it seems very clear that they do not belong to this primeval order of vegetable ruins.

The second order of fosil vegetables, comprehends those which are found in strata of clay or sand; materials which are the result of slow depositions of the sea or of rivers, agents still at work under the present constitution of our planet. These vegetable remains are found in such flat countries as may be considered to be of a new formation. Their vegetable organization still subsists, at least in part: and their vegetable substance has suffered a change only in colour, smell, or consistence; alterations which are produced by the developement of their oily and bituminous parts, or by their natural progress towards rottenness. Such are the fosil vegetables found in Cornwall, by Borlase; in Esex, by Derham; in Yorkshire, by De la Pryme, and Richardson; and in foreign countries, by other naturalists. These vegetables are found at different depths, some of them much below the present level of the sea, but in clayey or sandy strata, (evidently belonging to modern formation,) and have, no doubt, been carried from their ori-

ginal place, and deposited there by the force of great rivers or currents, as it has been observed with respect to the Miſsiſsippi*. In many instances, however, these trees and shrubs are found standing on their roots, generally in low or marshy places, above, or very little below, the actual level of the sea.

To this last description of foſsil vegetables, the decayed trees here described certainly belong. They have not been transported by currents or rivers; but, though standing in their native soil, we cannot suppose the level in which they are found, to be the same as that in which they grew. It would have been impoſsible for any of these trees and shrubs to vegetate so near the sea, and below the common level of its water: the waves would cover such tracts of land, and hinder any vegetation. We cannot conceive that the surface of the ocean has ever been lower than it now is; on the contrary, we are led by numberleſs phænomena to believe, that the level of the waters in our globe is much

* La Coudreniere sur les Depots du Miſsiſsipi. *Journ. de Phys.* Vol. XXI. p. 230.

below what it was in former periods; we must therefore conclude, that the forest here described grew in a level high enough to permit its vegetation; and that the force (whatever it was) which destroyed it, lowered the level of the ground where it stood.

There is a force of subsidence (particularly in soft ground) which, being a natural consequence of gravity, slowly though perpetually operating, has its action sometimes quickened and rendered sudden by extraneous causes, for instance, by earthquakes. The slow effects of this force of subsidence have been accurately remarked in many places; examples also of its sudden action are recorded in almost every history of great earthquakes. The shores of Alexandria, according to Dolomieu's observations, are a foot lower than they were in the time of the Ptolemies. Donati, in his natural history of the Adriatic, has remarked, seemingly with great accuracy, the effects of this subsidence at Venice; at Pola, in Istria; at Lisa, Bua, Zara, and Diclo, on the coast of Dalmatia. In England, Borlase has given, in the Philosophical Transactions *,

* Vol. XLVIII. p. 62.

a curious observation of a subsidence, of at least sixteen feet, in the ground between Sampson and Trescaw islands, in Scilly. The soft and low ground between the towns of Thorne and Gowle, in Yorkshire, a space of many miles, has so much subsided in latter times, that some old men of Thorne affirmed, "that whereas they could before see little of "the steeple, (of Gowle,) they now see the "churchyard wall*." The instances of similar subsidence which might be mentioned, are innumerable.

This force of subsidence, suddenly acting by means of some earthquake, seems to me the most probable cause to which the actual submarine situation of the forest we are speaking of may be ascribed. It affords a simple, easy explanation of the matter; its probability is supported by numberleſs instances of similar events; and it is not liable to the strong objections which exist against the hypothesis of the alternate depreſsion and elevation of the level of the ocean; an opinion which, to be credible, requires the support

* Gough's Edition of Camden's Britannia, T. III. p. 35.

of a great number of proofs, less equivocal than those which have hitherto been urged in its favour, even by the genius of a Lavoisier *.

The stratum of soil, sixteen feet thick, placed above the decayed trees, seems to remove the epoch of their sinking and destruction, far beyond the reach of any historical knowledge. In Cæsar's time, the level of the north sea appears to have been the same as in our days. He mentions the separation of the Wahal branch of the Rhine, and its junction to the Meuse; noticing the then existing distance from that junction to the sea; which agrees, according to D'Anville's inquiries †, with the actual distance. Some of the Roman roads constructed by order of Augustus, under Agrippa's administration, leading to the maritime towns of Belgium, still exist, and reach the present shore ‡. The descriptions which Roman authors have left us, of the coasts, ports, and mouths of rivers, on both

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* *Mém. de l' Acad. de Paris.* 1789. p. 351.

† D'Anville *Notice des Gaules.* p. 461.

‡ Nicol. Bergier. *Hist. des grands Chemins des Romains. Ed. de Bruxelles.* Vol. II. p. 109.

sides of the north sea, agree in general with their present state; except in the places ravaged by the inroads of this sea, more apt, from its form, to destroy the surrounding countries, than to increase them.

An exact resemblance exists between maritime Flanders and the opposite low coast of England, both in point of elevation above the sea, and of internal structure and arrangement of their soils. On both sides, strata of clay, silt, and sand, (often mixed with decayed vegetables), are found near the surface; and, in both, these superior materials cover a very deep stratum of bluish or dark-coloured clay, unmixed with extraneous bodies. On both sides, they are the lowermost part of the soil, existing between the ridges of high lands *, on their respective sides of the same narrow sea. These two countries are certainly coeval;

* These ridges of high lands, both on the British and Belgic side, must be very similar to each other, since they both contain parts of tropical plants in a fosil state. Cocoa nuts, and fruits of the areca, are found in the Belgic ridge. The petrified fruits of Sheppy, and other impresions of tropical plants, on this side of the water, are well known.

and, whatever proves that maritime Flanders has been for many ages out of the sea, must, in my opinion, prove also, that the forest we are speaking of was long before that time destroyed, and buried under a stratum of soil. Now it seems proved, from historical records, carefully collected by several learned members of the Brufsels Academy, that no material change has happened to the lowermost part of maritime Flanders, during the period of the last two thousand years *.

I am therefore inclined to suppose the original catastrophe which buried this forest, to be of a very ancient date; but I suspect the inroad of the sea which uncovered the decayed trees of the islets of Sutton, to be comparatively recent. The state of the leaves and of the timber, and also the tradition of the neighbouring people, concur to strengthen this suspicion. Leaves and other delicate parts of plants, though they may be long preserved in a subterraneous situation, cannot remain uninjured, when exposed to the action of the waves and of the air. The people of

* Vide several papers in the Brufsels *Mémoires*; also *Journ. de Phys.* T. XXXIV. p. 401.

the country believe, that their parish church once stood on the spot where the islets now are, and was submerged by the inroads of the sea; that, at very low water, their ancestors could even discern its ruins; that their present church was built to supply the place of that which the waves washed away; and that even their present clock belonged to the old church. So many concomitant though weak testimonies, incline me to believe their report, and to suppose that some of the stormy inundations of the north sea, which in these last centuries have washed away such large tracts of land on its shores, took away a soil resting on clay, and at last uncovered the trees which are the subject of this Eſsay.

ESSAY XL.

On the Propriety of uniting Trade and Literature.

If we look back through all the records of history, we shall find it generally allowed that the Phœnicians were not only the original inventors of letters, but that they were also the first people who distinguished themselves by their trade; and that they have ever since been held up as a proof to what height of grandeur, wealth, and power a nation may arrive, when learning is cultivated at the same time with commerce *.

Athens had her Piræus, her ports or docks, and thought "trade her life and glory †," at the time when her inhabitants carried the elegant arts to the utmost perfection—"free and independent as Sparta, able to defend its liberties in the field against the most numerous

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* Whose Merchants were Princes. Isaiah.

† Rollin.

and warlike people, it carefully attended to the encouragement of commerce, and brought home the wealth of the most distant climates to its own convenience and emolument*."

When Alexandria became the Emporium of all the trade between India and Europe, it was renowned for its learning; during the times of the Ptolomies, the succeſsors of Alexander, the trade of Alexandria flourished so much "that this city alone boasted of upwards of four thousand ships employed in trade,"—this was the period when canals were cut, when piers were formed, and lighthouses erected—it was at this period when the largest library that ever had been, or that ever has been formed, was instituted; and so long as commerce flourished in Egypt, so long was she esteemed for her learning.

By her commerce, Carthage was enabled for more than a century to withstand the whole force of the Roman Republic; and though her annals during this period of her history exhibit the names of but few learned

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* Athenian Letters.

men, yet "she poſseſsed some libraries, and to her schools the most powerful African princes sent their sons for education*;" but had Carthage cultivated learning as much as commerce, Punic faith would not have been handed down to posterity as a reproach to trade†.

Learning and commerce were both at their zenith in the Roman Empire during the Augustine age; and so long as Palmyra‡ enjoyed the trade of the East, so long was she the seat of learning and the arts. To what circumstance does she owe her present state, celebrated even in ruins, but to the loſs of her trade.

The revival of letters, after what is called the dark ages, was principally to be attributed

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* Rollin.

† The magistrates of Carthage ordained, that no citizen of Carthage should learn any other language than his own.

‡ Longinus was prime minister to Zenobia, Queen of Palmyra, "a judicious critic, if ever there was one."—*Milner's History of the Church.*

to commerce. The great family of the Medici, to whom we are so much indebted for bringing about that great event, were originally merchants, the bankers and loan-contractors to most of the crowned heads in Europe.

"The protection afforded by Lorenzo to all the polite arts, gave them a permanent foundation in Italy. In the establishment of public libraries, schools, and seminaries of learning, he was equally magnificent, indefatigable, and succesful; thus a private citizen and a merchant of Florence, not only obtained the decided control of that state, but raised himself to the rank of sole arbiter of Italy, and his descendants became connected by marriage to the first European sovereigns *."

At the time the Portuguese discovered the pasage to the East, round the Cape of Good-Hope, they stood the highest in the scale of literature. And learning was never so much cultivated in Spain as at the period of the discovery of America, for the purpose of trade.

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* Roscoe.

To the eager thirst after trade do we owe the greatest part of our knowledge of the north-west coast of America; and although under the present reign, discovery has been the ostensible object of all our expeditions to the great Pacific Ocean, yet his Majesty's Counsellors have always had an attentive eye to the extension of our commerce in all their instructions. From private adventurers, whose profefsed motives have been trade alone, have we procured an useful fund of literary and philosophical information, whether we consider our acquisitions in natural history, or the knowledge we have thereby obtained of the various governments that exist.

To the trade in furs we are indebted for all the information we have of the Hordes that acknowledge the Rufsian sway, and to the same source an acquaintance with millions of Chinese. A desire to participate in the trade of Tibet, has brought us acquainted with the *religion* of the grand Lama, and the *constitution* of the Birman empire, whose sovereign is said "to pofsefs more books than any other crowned head from the Danube to China *."

* Symes.

To what do we owe the proud station which this country now holds in the history of the literary world, but to the political consequence we have acquired by our maritime affairs. In the time of Queen Elizabeth, so little were the people of this country acquainted with the principles of ship-building, that all our large ships were built by foreigners, and purchased of them. And it was not till we had that enlightened monarch on the throne, that government afsisted private individuals for the extension of commerce.

It is true that a spirit of commerce as well as literature began to re-appear all over Europe, in the twelfth and thirteenth centuries, and this was the æra of the discovery of the magnet, but it was not till a century later that its application to navigation was adopted; and had not commercial enterprise been united with an ardent thirst after knowledge, this valuable discovery would not have been usefully employed.

The same may be said of every other branch of literature; for although the genius of a few great men broke through the mist of ignorance, it was not till after this period that

learning and commerce were generally diffused through this country.

Thus we see from the history of the world, in all ages, that commerce and literature have always gone hand in hand.

Much as the nation may boast of the learning of individuals, in her two Universities, I believe it is acknowledged that some of our trading towns have done more in the last fifty years toward the encouragement of literature, and the propagation of the arts, than both those ancient seats of learning*.

But the principle has its foundation in human nature; the mind of man is thrown into a state of the greatest exertion, by the stimulus of rivalry and bustle. Do we not always observe that those who have the most private concerns do the most for the public, and that those whose independency of situation makes life almost irksome for want of employ, scarcely ever engage in the discharge of public businefs; nay, I believe that every man who

* Manchester. Glasgow.

accustoms himself to the full and due employment of life, always feels that the more he has to do, the more his mind is alert and capable of business; and that the truest satisfaction results from industry. Happiness has been defined the enjoyment of health in body and mind, but health can only be preserved by an ordinate and duly adjusted application of the proper agents on each excitable part of the system: thus when the body is stimulated into muscular exertion, we feel and enjoy the pleasure of existence; but in the exercise of the body we enjoy only half of what we are capable. When the mind is stimulated to the employment of its faculties in acquiring learning, or in the application of that knowledge to useful and profitable purposes, we feel a pleasure which man considers as peculiar to his species; and when these different agents are exactly balanced in their operations, we feel true rational enjoyment; thus labour and study mutually assist each other in promoting happiness; and thus literature, or rather the desire to know what others have done and thought, naturally connects itself with the spirit of commercial enterprise.

I am very well aware that the modern philosopher who looks with such eagerneſs to the future amelioration of mankind, and who flatters himself were all his principles universally acted upon, that the world would be perfect, ridicules the spirit of trade, and considers its proſecution, however ſucceſsful, as deſtructive of every principle of virtue, as tending in the greateſt degree to debaſe the human mind, and to unfit us for the true enjoyment of life; but why are we to be governed by the opinion of a man, who shut up in his study, sees at a diſtance, through a tinted medium, the man of buſineſs enjoying in ease and plenty his well earned hours of relaxation.

Where do we find generosity and benevolence more conſpicuously pourtrayed than in the character of the true English merchant? Look to some of our noblest institutions, whether for the relief of the sick, the decent maintenance of old age, or in rewards for those who bravely defend their country, and we shall find, that it is to the ſucceſsful man of buſineſs that they chiefly owe their origin and support?

That commerce when accompanied with literature does not debase the national character, take but a view of the rival states of Athens and of Sparta; to him who prefers the savage liberty and black broth of the latter, to all the elegancies and refined pleasures of the former, I can only say I envy him not his taste.

To their intercourse with the world, by means of trade, did the Athenians owe that superiority so universally acknowledged, for nothing tends so much as trade to the circulation of industry, wealth, and happineſs through a whole people; it becomes a common tye to connect the distant parts of the most extended empire, and like the circulation of the blood in the natural body, conveys life, health, and warmth over the political.

To her commerce did Athens owe that superiority which her polished inhabitants manifested over those of Sparta *.

There are men of buſineſs who, by great natural talent and dint of industry, have ac-

* Rollin.

quired, without any learning, princely fortunes, and who are heard to deride letters, and to consider the time employed in study as wasted, but "knowledge is light, and the more a man "has of it, the better he will see his way "through the world."—In the opinion of Addison, "a man that has spent his youth in learning, will discharge his business as a merchant with more honesty than one that is ignorant, because he has been used to find in his books virtue extolled, and vice stigmatized—there will be at least this advantage in a liberal education, his prosperity will sit more gracefully upon him*."

Johnson has said, "that learning is the result of leisure†," and seems to infer that study and business are incompatible.

Learning considered only as a science to be enjoyed solely as a personal acquirement, or pursued merely for the pleasure and reputation it affords, can alone be attained to effect by leisure: the mind, like the body, must be constantly excited by an increase of stimulus; he who wishes to derive all his enjoyments

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* Spectator. † Rambler.

from learning, must be able to exhibit proofs of acquirements superior to those with whom he aſsociates, and this certainly requires leisure, and an absolute devotion to the object; but how few are there who can derive happineſs from such a source; and after all, this is but too often a mere selfish pleasure—nay, there is something of vice in the indulgence of our taste for literature without a useful object; the man who studies for his amusement and neglects to employ his acquirements, resembles him who privately indulges any of his paſsions for his individual sensual gratification; but the learning acquired by the active and inquiring man of busineſs, becomes in his hands a useful art, a virtue, and is made conducive not only to his own and family's happineſs and comfort, but to the general good of society; not merely hugged in selfish luxury, as by the recluse, but freely communicated to all his connections.

There is yet another good that will result from the consideration that commerce and literature are not incompatible, and that is an improvement in the plan of education for the rising generation, whose local situation and circumstances may adapt them for trade. It

has been too long the general opinion, if a youth showed extraordinary talents, or ascended with any uncommon celerity the first steps to literature, that it would be wrong to destine such abilities, or so much genius, to trade; to one of the learned professions he ought to be devoted: thus inferring that the cultivation of such abilities, and so much genius, would be thrown away in becoming a merchant—but is not "happiness our being's end and aim," and is not the successful employment of our abilities necessary to true happiness? why then destine one half of the brightest of our children to certain misery, for not one half* of those who are educated for professions are capable of finding support from the possession of the greatest talents. If then we act upon such principles as these, shall we not be justly chargeable with the future misery of our children; and truly miserable indeed is the professional man, who wishes, but has not the opportunity of employing his talents and acquirements to the great end of life!

Let us then determine by every effort in our power, to keep alive the spirit of inquiry;—

* Vide Dr. Smith's Wealth of Nations.

let us combine the best abilities with the best means of education in our sons who are destined for trade, and we shall live to see every trading and manufacturing town become the pride and boast of our country; for commerce and literature are not incompatible, and when united, are capable of affording the greatest sum of human happineſs.

CONTENTS

OF VOLUME SIXTH.

ADVERTISEMENT.

AFTER what the Editor has said in the Preface to the first Volume of these Eſsays, it will be almost superfluous to repeat that he will not consider himself as injured, but, on the contrary, as highly honoured by the insertion of any of the original papers of this collection, in the different publications appropriated to Agricultural concerns. A diſsemination of that kind will prove very useful to those persons who cannot conveniently become purchasers of expensive publications, and who, perhaps, stand most in need of such information.

YORK, March 24, 1804.

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ADVERTISEMENT.—Having had the satisfaction to see three Editions of this Work called for, during a period of twenty-four years, and as this will be the last to which I can expect to put my hand, I have only to expreſs my warmest acknowledgments for the favourable reception that my endeavours have met with.

A. HUNTER.

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