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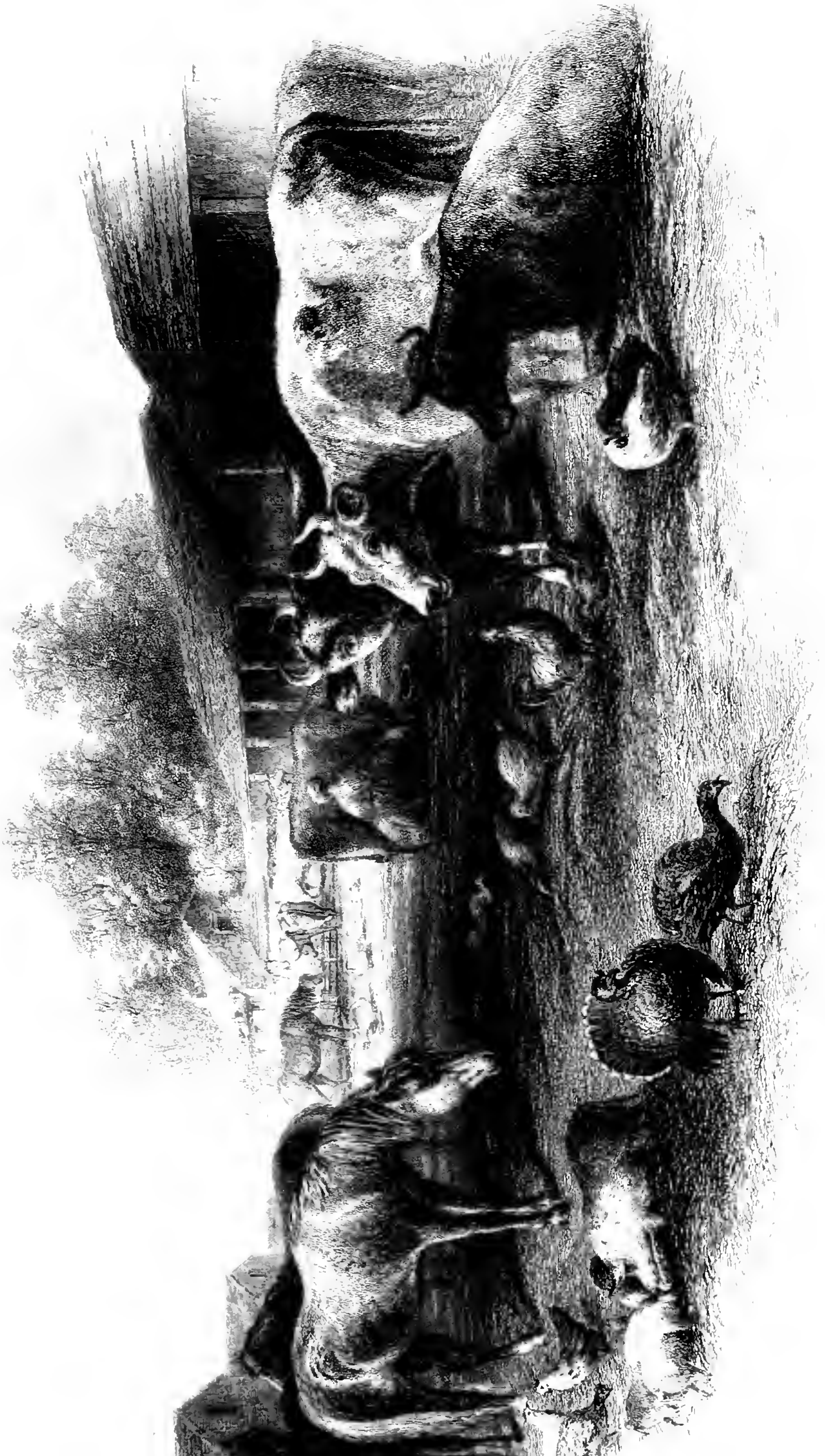

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Ancient and Modern

AGRICULTURE,

Ancient and Modern:

A HISTORICAL ACCOUNT OF ITS PRINCIPLES AND PRACTICE,

EXEMPLIFIED IN THEIR RISE, PROGRESS, AND DEVELOPMENT.

BY

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PREFACE.

The practice of Agriculture founded upon traditionary experience alone, was the rule until within comparatively a few years; and it is admitted that in the hands of a man of intelligence, the effect of such experience, when the operations are judiciously conducted, may be successful. The experiments, too, of such men, even when not associated with scientific knowledge, have frequently turned to good account. But the experience thus acquired could be of little use to the agriculturists at large, on account of the isolation of the individuals themselves, and the absence of those means of communication by which practical information is disseminated. So far, therefore, as the public benefit was promoted, the effect was confined within a very narrow circle, and the experiments probably died with the individuals with whom they originated, not every one being, like Tull, able and willing to commit his thoughts to print.

But there was another, and more powerful, and general cause for the little progress made by individuals of intelligence in the dissemination of their views, namely, the objection of the body of husbandmen to innovation, and their stolid indifference, or, rather, aversion to what they termed "book knowledge," which was a perfect bugbear to them. Nor is there any cause for surprise at this aversion, when we consider the condition of the rural population up to the latter part of the last century. Completely separated by the nature of their profession from mingling with the world at large, and holding daily intercourse only with a class still lower in intelligence than themselves, and equally wedded to the opinions and practices of their forefathers,—never mixing even with those of their own profession, except at fairs or markets, when the business of the day was too frequently concluded by a low debauch,—without the means or inclination of receiving or communicating knowledge, they were content to follow in the steps marked out for them by their ancestors, and, as they expressed it, "let well alone." It may be readily conceived with what spirit the first attempt to unite Science to Agriculture, theory to practice, was received by the men whom we have described. The large majority scouted the idea; and even some of the most enlightened doubted whether it could be productive of any practical benefit; and it was only after many years of persevering experiments that Sir Humphrey Davy's propositions were accepted and adopted on the farm.

We must not blame the husbandman for this tardy acceptance of the boon thus offered to him, when we reflect that it is only during the last two centuries that Science herself has emerged from the dreamy philosophy of the alchemists, and taken that place on the pedestal of truth which nature has assigned to her. With all the means and appliances at hand to direct and assist in their researches, the human race had existed nearly six thousand years before chemistry began to emerge from the darkness by which it was enveloped. Step by step, from the time of Van Helmont,* the last of the alchemists, with painful and persevering industry have the men of science felt their way, groping in obscurity, to that broad daylight of knowledge, the results of which have conferred unbounded benefits on mankind in every department of life, and in none to a more important extent than in that of the husbandman, who is now eager to bring all the physical sciences to bear upon the operations of the farm.

Practice without Science in Agriculture may be compared to a man with only one arm, and science alone is equally inoperative. As an illustration of this, science demonstrated, by the experiments of Margraaf, that the Silesian beetroot contained five or six per cent. of sugar. This was in the year 1747, but it remained merely a curious fact until the beginning of the present century, when the necessities of the French in regard to a supply of sugar suggested turning the discovery to account; and it is now one of the most important manufacturing industries in that country. Science and practice united prove the truth of the familiar adage, "Knowledge is power." A horse in a mill is a prince of blindfold workers compared with the husbandman who works on, wilfully shutting his eyes to the means offered to him of ameliorating his land, and doggedly persevering in the path beaten for him by his ancestors, equally ignorant with himself. The number of such we believe to be now small, and they are diminishing every day. Railways and a free press coming in aid of Agricultural Associations have wrought miracles of enlightenment upon the minds of the cultivators of the land, and an enemy to science amongst them is as much out of date as the dodo amongst birds, or mastodon amongst animals; he belongs to a fossil age.

The writer of this Work commenced farming just at the period when new views of the nature of Agriculture began to be entertained. It was a fortunate circumstance for him that his father, who for many years farmed his own estate of nearly 400 acres, in Norfolk, was, what was very unusual amongst agriculturists of that period, a large reader, as well as a deep thinker, and familiar with all the agricultural and general literature of the period. He fell in at once with the views of Arthur Young, so that the writer had the advantage of being able to study the works of that eminent man, and to see his system carried out in practice so far as the nature of the land justified it. At that time, also, the new husbandry, founded on the theory of Young, was in full operation on the far-famed Holkham estate, and the successful result of the system began to have its influence on the surrounding country. The annual sheep-shearings, instituted by Mr. Coke, purely in order to give greater publicity to the new method of farming by an exhibition of its practical superiority, afforded those who attended them an excellent opportunity of studying the difference between an enlightened system of husbandry founded upon scientific principles and one based alone on traditional practice. The writer attended these interesting and instructive meetings for many years, and has since witnessed the universal triumph of the principles first practically exemplified on a large scale by the founder of those noble and patriotic institutions. Chemistry, a perfectly new subject to the agriculturist, first found a patron for its introduction on the farm in the Holkham chieftain; and Sir Humphrey Davy, and other eminent chemists, appeared at those meetings to establish the fellowship between Science and Agriculture.

* Van Helmont died in 1644, at the age of 67, thereby giving the lie to his pretensions to the possession of a medicine by which he could prolong his life to an indefinite period.

About the year 1820 the interests of the writer led him to leave the country and reside in the metropolis. Engaged in other pursuits than agriculture, but still nearly connected with it, and holding intercourse with many agricultural friends, he continued to watch with a lover's eye the progress of improvement in that his favourite branch of rural industry. After some years, an engagement with a friend caused him to settle in Ireland, where, in addition to the business which took him thither, he occupied himself in cultivating a few acres of land attached to the house in which he resided. In 1848 he made an engagement with the editor of the *Advocate* newspaper (at that time the best agricultural and industrial journal in Ireland), as a writer on agricultural and other subjects. This engagement he retained until 1853, when he returned to London, and immediately obtained employment in the same capacity from the editor of the *Mark Lane Express,* which paper he is still connected with; and it has brought under his immediate consideration the opinions and practical experience of the most eminent farmers in every part of the United Kingdom, as well as on the Continent. With such preparatory experience, he did not hesitate, when called on by the publishers, to undertake the present Work, of which he thinks it proper now to give a brief account, as it differs in some respects from all previous works of the kind. In reading a great number of these, it has occurred to him that the nature of landed property is seldom or never touched upon, and that where referred to, very slight and inadequate ideas are conveyed respecting it. In Part I., Vol. I., he has therefore given a concise historical account of the origin of property in land, commencing with the patriarchal, which merged into the feudal system, and describing the processes by which the various tenures now existing were established; also the value of land at different periods of history, and some of the most important laws by which it is governed. Part II. contains, with a short history of the rise and progress of Agriculture in England, a brief sketch of that of other countries, principally adverting to the hindrances existing to its advancement, and the efforts making to counteract those impediments. Part III. relates to the connection of Agriculture with physical science, giving a sketch of those sciences immediately applicable to the farm. Part IV. relates to the domestic animals of the farm, their various species and varieties, and a history of those improvements in the various breeds which have raised their character and value in every part of the world. Part V. gives a history of the vegetable kingdom, and the various kinds of agricultural produce. Part VI. contains an account of British husbandry, the different kinds of farms, the implements and machines employed in husbandry, the history of steam cultivation, and all the newly invented machines for lessening the amount of hand labour. Part VII. relates to different modes of draining and fencing, manures, the dairy, irrigation, soils, seed, &c.

In Vol. II., Part VIII. commences a calendar of operations under the title of "The Seasons and their Engagements." It is divided into four seasons, namely—1st, autumn, and early winter; 2nd, winter, and early spring; 3rd, spring, and early summer; and 4th, summer, and early autumn. The writer makes the agricultural year begin at the close of harvest, which ought to be early in September, but is too often protracted in many parts of the country to the following month. The first season, therefore, is concluded at the end of November, the second at the end of February, the third at the close of May, and the fourth with August, or the harvest month. The operations on the land and at the homestead falling due in each of these periods, each of which is distinctive enough to form a separate series. are described in their several order of arrangement. If these are disregarded, and the work of one season *unnecessarily* thrown forward into the next, in many cases it would throw the whole routine of the farm into confusion. The word "unnecessarily" is put in italics because, in some cases, the seasons are so unfavourable that it is impossible for the best management to keep the work ahead so as to secure the execution of every operation in the proper time. Such was the case in 1852-3, when little more than half the breadth of winter wheat could be sown, and much of that which was put in was destroyed. This portion of the work gives general directions for the execution of all the important operations of the farm during the year, which, however, will be varied to meet the differences of soil and climate. In this respect it is the most practical part of the book as regards the ordinary farm-work, and will, it is presumed, be found, when coupled with the information scattered throughout the rest of the Work, sufficiently copious for reminding the farmer of the work to be performed, and the manner and time proper for doing it.

Part IX. contains a list of "auxiliary plants," or those not generally cultivated on the farm, but yet sufficiently so to render a notice of them necessary. Also the treatment of forests and plantations, with a list of forest trees, and the method of cultivating them ; farm buildings, the apiary, the veterinary department, agricultural manufactures, insects, quadrupeds, and birds, injurious to the farm ; insurance, farm accounts, and a variety of other subjects of interest to the farmer, some of which are seldom enlarged upon, or even referred to, by writers on agriculture, and will therefore be new to the generality of readers. It has been the Author's endeavour to enliven what is in some respects a somewhat dull detail, by the insertion of anecdotes illustrative of the subject in hand. Many of these he has related from personal observation, whilst others are such as he has met with in the course of his reading, in which case the source from whence they were derived is referred to at the bottom of the page.

In the compilation of the Work—for it would be presumption and folly in him or any other person to profess to have written such a book from personal experience alone—the writer has availed himself of all the most eminent works of husbandry, ancient and modern, that the noble library of the British Museum supplied. A list of most of these will be given at the end of the table of Contents; but he wishes specially to mention the aid he has derived from Stephens's "Book of the Farm," and Morton's "Cyclopædia of Agriculture," which he considers the best modern works of their several kinds hitherto published : the first as an elementary treatise for the use of the agricultural student, and the second as a book of reference in an alphabetical form. Whilst, however, acknowledging his obligations to other authors, he makes no scruple of stating, that he has in every case exercised his own judgment, and weighed well the substance of the information he has met with, and compared it with his own experience as far as that would go, and with that of his friends, whom he had an opportunity of consulting.

In some important instances his opinion has materially clashed with those of practical agriculturists, and in none more than on the construction and operation of the modern plough, and on the present and future status of steam cultivation. With regard to this latter subject, he has been censured by the reviewer in a weekly publication,* for having given too much space and too prominent a position to Halkett's Guideway system, whilst Fowler's, Howard's and Smith's round-about systems, which are *at present* the only ones in full practical operation, have been allotted much less space

* *Gardeners' Chronicle.*

in the Work. After reading what the reviewer has said on the subject, and re-considering the matter, he still maintains his opinion, that steam cultivation is in a transition state; that the present working systems, by being limited to *one* operation of the farm, are as far from developing the power of steam on the land as Handcock's steam omnibus was helpless in the extension of the traffic in goods and passengers; and that, lastly, the present state of agriculture in regard to the competition in cereal produce with foreign growers, will soon necessitate the adoption of more economical modes of cultivation. The writer is fully convinced that were the Halkett system adopted, the whole of the farm operations would be conducted at half the present expense, whilst the produce of the land would be greatly increased. This is the only way in which the British husbandman can meet the foreigner, namely, by reducing the expense of cultivation to the *minimum*, and increasing the produce to the *maximum*. Let these objects be accomplished, and no foreigner would be able to compete with us.

Steam cultivation the writer considers the great agricultural question of the day—the turning-point upon which hangs that of profit or loss by the occupation of the land. If the landlords knew their own interest, and cared for that of the tenants, they would not neglect making permanent improvements. But the indifference they display, as a body, in availing themselves of the facility offered by the Government for draining their lands, affords little prospect of their laying down the land with rails at an expense of eighteen or twenty pounds per acre; and it would be madness for a tenant-farmer to do so without a tenant-right guaranteeing to him remuneration *at the expiry* of his lease. It is therefore probable that only by the combined capital and enterprise of a public company will the Guideway system be inaugurated in the United Kingdom. The writer is too old to expect to live long enough to see it carried out, but he ventures to declare his conviction that such a company, under proper management, would not only confer a lasting benefit on the country by setting a splendid example, but would prove one of the most profitable enterprises of the present day, if properly conducted.

The writer considers the present condition of the land of England to be very unsatisfactory, chiefly owing to circumstances which nothing less than legislative interference can rectify. The chief obstacles to the improvement of the land, and the full development of its productive powers, are—first, the law of entail and inheritance, or primogeniture; secondly, the want of a tenant-right; thirdly, the game laws; fourthly, the arbitrary power of the landlord over the tenant.

The first of these is an impassable barrier to all improvement of estates, by making it imperative, as a matter of justice, for the present owner of an entailed estate to save every shilling in order to provide for the younger branches of his family in case of his death, instead of expending it in permanent works, however reproductive, the benefit of which will accrue to the eldest son, as the inheritor of the property, sooner or later. This more concerns the female than the male children, because these latter are sure, in one way or other, to be fastened upon the country, by official appointments either civil, military, or ecclesiastical, however unfit they may be to fulfil the duties belonging to them. The female members of a high family have but little chance of a settlement in life adequate to their rank, unless they can bring with them a fortune; and to provide this the noble owner of many an estate is compelled to allow it to remain in an unproductive, or at least half-productive state during his whole lifetime, to the injury of every one concerned in it.

The second cause shuts out all permanent improvement by the tenant, who is restricted from cultivating the land he occupies to advantage, being compelled by his own interest to farm, as it were, from year to year, and to expend nothing upon the land but what he can reap an immediate benefit from.

The third cause, which allows the landowner to keep up enormous heads of game at the expense of the tenant, without any remuneration, or the liberty of killing a single bird or hare for his own use, is bad enough in all conscience; but it is rendered still more oppressive by the new laws made by certain owners of estates in the Midland Counties, by which their tenants are prohibited from employing reaping and mowing machines, and from ploughing within a certain distance of the fence, or cutting the brushwood on the borders, because all these operations destroy the harbour for the game, and spoil the shooting. We know not whether the tenants of these petty sovereigns have submitted to this tyranny; but if they have, it is as little to their credit as Englishmen as the laws themselves are to their landlords.

The fourth cause is equally serious and injurious. The covenants are too frequently stereotyped in all leases and engagements for land; and, being drawn up by persons ignorant of husbandry, and without any regard to the nature of the land, and the difference of soils existing upon the property, render it imperative on the tenant to farm to great disadvantage. Like the bed of Procrustes, these restrictions are continually cramping his operations, interfering even where the property itself would be the better for a deviation, whilst it would promote the interests of the tenant. These subjects are all treated on at greater length in the Work, especially that of the game laws, which the writer considers to be the most injurious to all parties concerned, and the most requiring the interference of the legislature. If the writer has spoken with bitterness on this subject, it is because he has seen glaring instances of injustice in all parts of the country perpetrated by the upholders of the excessive preservation of game, who *rob* their tenants to gratify their selfish vanity. We see nothing in such men of the "old English gentleman," who looked upon his tenants as his children and friends, and consulted their interests as well as his own. The game was preserved for fair sporting; and if the tenants were not allowed to shoot it, the lord took care to send them a portion whenever he or his friends had a day's shooting. The game laws are one of the last relics of the feudal system, and the worst; and the sooner they are abolished, the better will it be for the landowner, the occupier, and for the country at large.

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AUTHORITIES CONSULTED IN THE COMPILATION OF THIS WORK.

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Sir Hugh Platt's "Garden of Eden."
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AGRICULTURE, ANCIENT AND MODERN.

PART I.—LAND.

SECTION I.

THE HISTORY OF THE APPROPRIATION OF LAND.

The word "land" has commonly two main significations. In its broadest and most general sense it implies one of the two grand divisions of the surface of the globe, of which it constitutes one-third. In a more restricted sense it signifies that portion, or those portions of the surface which are appropriated by mankind as a possession, for the purpose of raising the means of subsistence. It is in this latter application of the term only that we have at present to treat of it.

The instinctive claim in the human mind upon the land is not confined to man in his civilised state. It is found as strongly developed in the nomadic tribes, who wander over the hunting-grounds of their native country in search of a precarious existence. There is, in fact, no race of people on the face of the earth so far reduced to a level with the inferior animals as not to feel that they have a claim upon the soil which gave them birth, or who will not defend that claim to the utmost of their power against the encroachments of others. This feeling may be traced back to the earliest ages of mankind; and we are indebted to the sacred writings for the first historical record of an individual appropriation and sale of land: the narrative of the purchase by Abraham of the cave of Machpelah and the field Ephron from the sons of Heth* is interesting, not only for the striking facts it relates, but as a specimen of the primitive manners of Eastern nations at that early age of the world, and of the dignified, honourable, and gentlemanly bearing of the old patriarch, who, feeling the elevation of his position as a man of wealth and influence, courteously refused to accept the possession as a free gift, and paid at once the full price for it, as fixed by the proprietors.

When the patriarchal ages had passed away, and the greater dispersion and increase of mankind began to suggest and extend the idea of a public interest, it was found necessary to invest individuals with certain powers that would qualify them to protect the weak from the attacks of the strong, and to promote the general interests and welfare of the society to which they belonged. It was natural that, in the first instance, the new government should be modelled upon the patriarchal plan, and that the head of the oldest branch of a tribe should govern the tribe, and hold, in trust, the territorial property belonging to, or conquered by it. But it has been found by experience that this principle, however applicable to a family, and possibly to a small tribe in a rude and primitive state of society, almost inevitably leads to a condition of slavery; and those nations, in the East especially, who have adhered to it, have invariably in a few generations fallen under the despotic sway of one man, by whom the natural rights of those he governed were disregarded.

The first instances recorded in profane history of a departure from the patriarchal form of government, are those of the free states of Greece. These placed the supreme power of the state in laws made by the mutual consent of the people, and the land was divided amongst the latter according to their families. Their example was copied by Romulus in establishing a colony at Rome (B.C. 753), the founders of which carried out the principles, both of law and government, they had derived from the Greeks. A portion of land—two *jugera* †—was allotted to each freeman, that being considered sufficient to support a family; and laws were enacted to prevent either a subdivision or the amalgamation of the lots. Each lot was the property of a Roman, which could neither be taken from him nor sold by him. As the people increased in numbers, bands of young men were sent out to procure by conquest fresh tracts from the weak states of Italy, by whom Rome was surrounded. Thus their power and influence were extended in every direction, the two arts of war and agriculture being the only ones to occupy them, there being no commerce. In process of time, however, this plan was found not to succeed, on account of the scarcity of labour in a community where every one was a proprietor, except the slaves, who were inadequate to the task; consequently, the land was very imperfectly cultivated. As, therefore, the patricians obtained fresh tracts, they compelled their plebeian debtors, who were numerous, to cultivate it for them, to the neglect of their own lands. The laws of the Twelve Tables,‡ the first regular code of

* See Gen. xxiii.

† The *jugerum* was about three-fourths of an acre, or as much as one yoke of oxen could plough in a day.

‡ So called, either because the Romans then wrote with a style upon wooden tables, covered with wax; or because they were engraven on tables or plates of copper, to be exposed in the most conspicuous part of the public forum.

laws enacted by the Romans, and which originated in the jealousy of the patricians of the power of the plebeians, made provision for the subdivision or alienation of the landed property of the citizens. Some learned critics, however, have held that the clause which is supposed to refer to the subdivision of the land, had rather an allusion to the dismemberment of the debtor's body, when he could not pay his creditors in money.

Being destitute of commerce and manufactures, the Romans were continually under the necessity of extending their empire by fresh conquests. By this means, the civilization of that people communicated itself by degrees over the Continent, and was in process of time conveyed to Britain, upon the conquest of that island by the Romans.*

Whilst the ancient Germans remained in the woods, the patriarchal system prevailed. The land was the property of the tribe, and was cultivated for the general use. The practice of agriculture, however, was considered degrading, and was, therefore, hateful to the free Germans. Their warlike and predatory habits frequently put them in possession of fresh tracts of land; but these accessions of territory, to a people who despised the arts of peace, and were unacquainted with a private or individual property in land, were rather burthensome than acceptable. They therefore returned the conquered tracts to the vanquished, *on condition* of receiving assistance from them in their wars. This principle, applied in the first instance to conquered enemies, was afterwards adopted in the case of weak states. These, dreading the aggressions of more powerful nations, voluntarily resigned to them their lands, and received them back on the same condition of military service.

The cultivation of the land was performed by one half of the tribes alternately, the other half being usually engaged in war. Thus the whole nation, like the Romans, became expert in both occupations, and at the same time ensured the continuance of their freedom. But when the advance of civilization, consequent on an intercourse with other nations, had introduced the idea of a private property in land, grants of land were made by the sovereigns to military leaders, in return for their services. These allotments were proportioned to the dignity and merits as warriors of the individuals; and they were again distributed by them amongst their vassals, always on the same condition of military service. In the first instance, these arrangements were subject to the caprice of the grantor, who might, at a moment's warning, deprive his retainer or vassal of his possession. Afterwards, it was assured to him for a year; then for a term of years; at a later period, for life; and, ultimately, the property was allowed to descend to his heirs.

These feudal tenures gave rise to a variety of terms still in use in English courts of law. Thus, *fealty* consisted in an oath of attachment and obedience to the prince or chief; *homage* was an acknowledgment on the part of a vassal of his lord's superiority. *Wardship* arose after the feudal tenure merged into a life-possession, or inheritance. Upon the death of a holder of land, the lord took the infant son and heir under his protection, both for the security of his person in those wild times, and for the improvement of his manners. He even exercised a power over his ward in the choice of a wife (or husband, if a female), and he was given in marriage to the most honourable

* It is remarkable that the Romans never lost a foot of ground they had acquired by conquest. Agriculture and war being their only occupations, their armies were bodies of husbandmen, who settled on the lands they had conquered, and every husbandman was necessarily a warrior.

and powerful of his contemporaries. *Relief* was a fee or present, given by a retainer or vassal to his superior upon receiving a *fief*, or portion of territory, which had reverted to the lord upon the death of a former holder. *Aids*, or *benevolences*, were voluntary contributions, granted to the prince by his vassals, upon extraordinary occasions—as the marriage of his daughter, the redemption of his captive family, or to furnish a feast upon the introduction of his sons into life. An *escheat* was the expulsion of the retainer by his prince, or vassal by his lord, as a punishment for perfidy or cowardice, and the term was also applied afterwards to the resumption of a *fief* by the prince or lord on the failure of heirs.

Such was the nature and origin of the feudal system. In the advance of civilization, and the increase and consolidation of society, military service, by which *fiefs* were held, was commuted for a consideration in money. The change of manners, the establishment of regular governments, which afforded protection to the persons and property of individuals, the extension of commerce, and the growth of luxury,—all tended to produce a decay of the feudal system. Princes found greater subserviency and submission in hired troops than in their independent and turbulent subjects; whilst the latter, enervated by the arts of peace and luxury, found it, on their part, more agreeable to remain at home and lord it over their vassals, than to risk their persons and estates by war. They therefore compounded for their military services by payment of a sum of money. Thus, in process of time, the relative obligations of prince and retainer, and of lord and vassal were changed, and the more onerous parts of the system were ameliorated, or fell into desuetude.

The revenues of the Saxon monarchs in the early ages were very limited. The decline of the feudal system diminished their influence and authority step by step, until it was reduced exceedingly low. The lands retained by them were inalienable, and the people possessed an interest in them, so that they could not dispose of them, even for pious uses, and still less for private advantage. In some cases it was considered common property, but still held on a feudal tenure. These *allodial* lands were called by the Saxons, *Folk-land*, or *Reeve-land;* whilst the extensive tracts held by written contract were termed *Book-land*. All history proves that a private property in land had its origin in common property, and that, therefore, the owners have no right in the soil but by permission and for the benefit of the state.

Nor were the prerogatives of the Saxon kings absolute. They could not declare war or make peace without the consent of the great council of the nation. The crown was considered by them as the gift of the people; and although it frequently descended from father to son, it was by the election of the people alone that the claim of the latter was established. Even after the right of succession began to be admitted, the people sometimes recurred to the same free mode of election when their rights were invaded by the sovereign; and the crown was bestowed upon a more approved chief. Thus, the regal dignity was made to accord with and subserve the national freedom; and the great principle that the kingly office was established for, and must be subservient to, the public good alone, was recognised and acted upon by those rude warriors who afterwards founded the British monarchy.

The German nobility were numerous and powerful. They resided in baronial castles, the centres of vast tracts of land, and capable of containing many hundreds, or even thousands of their vassals, whence they were able to defy their enemies. The

*Earls Palatine** possessed a superior authority to the simple earls; their privileges and jurisdiction were unbounded, whilst those of the latter were limited and precarious, and their territorial possessions much inferior. Next in rank to earls were the *Companions,* who in Germany were equal to the *Thane*† in England; these sometimes obtained grants of land of great value for their services to the prince in war. The allodial or independent proprietors were *Freeholders,* and stood next in rank to the *Companions.* Fighting under a leader of their own choice, they took possession of lands that were previously unoccupied, and appropriated them to their own use. Their jurisdiction was very limited, and they were neither encouraged by the sovereign nor the nobles. Envying, therefore, the superior privileges of the feudal holders of land, they surrendered their free possessions to the prince, and received them back as *fiefs* on the feudal tenure. The *Ceorles* were tenants of the lands of the chief, and paid him a certain proportion of their corn, cattle, &c. Being tenants at will, they were liable to be ejected at pleasure; but this power was seldom exercised. The last order of men were *Slaves,* or *Villeins,*—the "hewers of wood and drawers of water" of the privileged classes, and attached by birth and service to the soil. Depending on their masters for subsistence, they could legally possess no property, and were sold or put to death by them with impunity, no price being ever set upon *their* heads, as was the case with all others. They were, however, generally treated with forbearance by their masters, and in time of war frequently obtained their freedom by their valour. In such cases they were presented with the spear and shield; and if they remained a year and a day in a privileged town, the laws gave them their liberty. Thus the meanest in the community were not absolutely debarred from improving their condition and rising in society, the duties of which were consequently performed with greater vigour and alacrity, and civilization and the arts of life advanced under the fostering hand of freedom.

It would appear probable that the agrarian law introduced by Romulus into the Roman colony, and previously practised by the states of Greece, were of a much earlier date than either the Greek or Roman commonwealths. From the history of Joseph, in the sacred writings, we learn that the Egyptians possessed lands of their own individually; for when the seven years of famine occurred, and were in progress, Joseph bought the lands of the people for Pharaoh in exchange for wheat, and afterwards put them again in possession of them, on condition that *one-fifth* of the produce should belong to the king, and the remaining four-fifths to the cultivators, for seed and for food for their families; and this regulation, it is added, "became a law in Egypt," at least to the time of the Exodus of the Israelites, which was between four and five hundred years after; so that during that time the land of the whole country, except that which belonged to the priests, was the property of the sovereign, held by him in trust for the benefit of the whole community, as the terms on which it was returned to the former proprietors go to prove. The tenure of the latter, in fact, was very similar to the feudal tenants in Germany, who surrendered their lands to the prince and received them back as fiefs, on the usual condition of military service, which in Egypt was commuted for what may be called a corn-rent. The narrative justifies the assumption that, from the earliest ages of mankind, the state, whether under the patriarchal, monarchical, republican, or any other form of government whatever,

* The word *Palatine* implies the possession of regal privileges and immunities.

† *Thane* signifies "a servant." Hence the motto of the Prince of Wales, derived from that of a German prince, "Ich *dien,*" or "*thien,*" "I serve," the Germans not being able to pronounce the dipthong *th* otherwise than as *d.*

has been the trustee, or custodian, of the land of the country for the benefit of the people at large, and that private property in land is an institution first established by the state, and still remains subject, in all respects, to the exigencies of the state; so that no man can have an inalienable right in it, if the welfare of the community requires its surrender in whole or in part. This claim on the part of the state, however, does not bar that of the proprietor to compensation, to the full extent of the loss he would otherwise suffer. We see this principle acted upon on an extensive scale in the case of railways, canals, public roads, and other works undertaken for the general benefit of the community; and upon a still more extended one in that of the "Encumbered Estates" in Ireland, which, by virtue of an act of parliament, have been compulsorily sold, under the fiat of, and by, the commissioners appointed for the same by the government, to the value of nearly thirty millions sterling in ten or twelve years, for the express reason that a large proportion of them were so hopelessly involved in mortgages, legacies, dowries, &c., &c., as to be of little or no value to the proprietor, the mortgagee, the occupier, or the country at large.

In the freest country in the world, therefore, a man has no inalienable property apart from the state, except his own person, and that claim upon others arising out of the exalted character of humanity and the general obligations of society. He can claim the fruits of his own labour and skill, because these are portions of himself, the efforts of his head and hands imparted to a given subject in a specific form. But even these are not absolutely inalienable, because the form itself is evanescent; and when that passes away, the right ceases. Thus, a man rears an ox or a sheep; he knows that if he keeps either beyond a certain age he loses them, or by them, and he therefore disposes of his right in them under the compulsion of that conviction. The money he receives for them is his compensation for the loss of them. If either should die in the mean while, he loses his claim altogether; and the state also is a loser, because the public good is but an aggregation of private good. No individual member of a community can suffer without the state also suffering to a greater or less extent, according to the nature or amount of the individual injury.

"The state therefore," says Kant, "is not a combination of landed proprietors, for these have become such only by means of the state itself; and it is just as absurd to derive the existence of the state from something that receives existence from it, as to consider nobility older than sovereignty and independent of it. This is against all history; for the soil at an early period was common to all the inhabitants, and at a subsequent period it was regarded as the rightful possession of a certain family or community. But the origin of a family property can only be traced to the immediate gift of a higher power. Canaan was promised to Abraham by the divine Being; and the American Indians claim the right to their hunting-grounds by the gift of the 'Great Spirit.' Hence tithes and the division of land into separate properties or possessions, is the natural effect of an increase of population." The British legislature has recognised the correctness of the principle here laid down, by abolishing the territorial qualification test in the admission of members to the lower house of parliament,—a recent and tardy act of justice, which, had it been rendered a few years sooner, would probably have saved the country from a large portion of the national debt.

All the nations of Europe have acted upon the principles laid down in the foregoing observations, and have not allowed land capable of cultivation to be unimproved. In some cases they have carried their interference so far as even to prescribe the mode of cultivation, and have limited or forbidden the culture of plants that contribute nothing to the sustentation of man, as tobacco; and have encouraged that of others. It is, however, a question whether this interference may not be carried too far by too much checking private enterprise, and tampering with the right every man possesses of making the most and best of his skill and industry.

The nature of the claim or right by which landed property was held in England previous to the Roman conquest of the island is involved in great obscurity. Agriculture had been introduced by the Gauls, who had crossed over from Calais and other points of their coast nearest to that of Albion, and taking quiet possession of unoccupied lands, cultivated them successfully, and thus instructed the native Britons in the art. This, according to Cæsar,* was about a hundred years before he arrived in the country. The Romans, who were well skilled in husbandry, introduced their system, and effected great improvements, so that large quantities of both corn and wool were exported annually to the Continent. It is evident from this circumstance that they did not dispossess the natives of their lands, but rather, by taking possession of unoccupied tracts, and cultivating them according to their own methods, conferred a benefit upon them. The smallness of the population compared with the extent of the country rendered land of little value; and it is probable that the cultivation of a portion for a certain time gave the occupier a title to it. Nor did the Romans annul the laws by which, under the Druidical system, the Britons were governed; these were the code of *Dunwallo Molmutius*, which was enacted about four hundred years before the birth of Christ; and the Romans, instead of cancelling, engrafted many of their own upon it, according to their usual custom. The Britons, therefore, were governed by that code until the year 408 of the Christian era, when Constantius, the reigning emperor, finding that the troubles of the empire at home rendered it impossible for him any longer to govern so distant a province, drew together a vast mixed army of Romans and Britons, and with them abandoned the island.

No sooner were the Britons left without their defenders, than the Picts and Scots ravaged the country without mercy. The natives having in vain implored aid from the Romans, turned their eyes to the Saxons, who about the middle of the sixth century landed on the island; and, having quickly driven the Picts and Scots back to their barren fastnesses, subdued, in their turn, the Britons also, and at different intervals established the seven independent kingdoms of the "Saxon Heptarchy."

"No conquest," says Stewart, "made by any tribe of barbarians was half so terrible as that of the Saxons. Other nations lived and mixed with the ancient inhabitants of the countries they subdued; but the Britons were so entirely exterminated, that few traces remained of their own laws and peculiar customs, or of those which were imposed on them by the Romans; and philologers have observed that there is not remaining *a single British word in our language.*"

The few remaining inhabitant natives that escaped the massacres of the Saxons retired into Wales, where, although there was less scope for agriculture, necessity compelled them to practise it. Their agrarian laws appear singular at the present day. No man was allowed to guide a plough who could not construct one, and it was enacted that the ploughman should also make the ropes of twisted willow, or osier, with which it was drawn.

* Cæsar, "De Bell. Gall.," lib. v. c. 12.

If any person laid dung upon a field with the consent of the proprietor, the law gave him the use of the land for one year. If the manure was carried out in a cart in large quantities, he had the use of the land for three years. If a man cut down a wood with the consent of the owner, and converted it into arable land, he was to have the use of it for five years. If any one folded his cattle for one year, upon a piece of ground belonging to another, with the consent of the owner, he was allowed the use of that field for four years. The Britons, therefore, in the barren mountains of Wales, did not lose their love of agriculture; but it was otherwise with their conquerors, the Anglo-Saxons.

These invaders having exterminated the Britons, and taken possession of, and divided, their lands, found themselves on the point of starvation. Hating agriculture and the other arts of peace, they were, nevertheless, compelled to have recourse to it; but they enacted laws to prevent its being followed by any except women and slaves. The princes and great men amongst them, who had received the largest shares, are said to have divided their estates into two parts, which were called *inlands* and *outlands*. The former, being those which lay contiguous to the mansion-house of the owner, he kept in his own occupation, and cultivated them by his slaves, under the direction of a bailiff, for the purpose of raising provisions for his family and numerous vassals. The *outlands* were those at a distance from the house, and were let to the *ceorles*, or farmers, at very low rents. At the beginning of the eighth century, Ina, King of the West Saxons, enacted a law by which "ten hides or plough-lands,"* constituting a farm, was to pay the following rent:—"Ten casks of honey, three hundred loaves of bread, twelve casks of strong ale, thirty casks of small ale, two oxen, ten wedders, ten geese, twenty hens, ten cheeses, one cask of butter, five salmon, twenty loads of forage, and a hundred eels." By this account it appears that the land was both divided into large estates and large farms at this period, as ten hides were equal to from six hundred to twelve hundred acres.

The most remarkable arrangement of the land of England was made under the reign of Alfred the Great, towards the close of the ninth century. Upon the expulsion of the Danes by that king, he divided the whole country into small sections, called *tithings*. The towns constituted separate jurisdictions, and were distinguished by the name of *town tithings*, whilst the others were called *rural tithings*. The management of each *tithing* was vested in all the inhabitants paying "scot and lot," and these also annually elected the magistrates and other local officers. The chief officer of a tithing was charged with the executive authority, but the legislative power was committed to a local council. So excellent, complete, and efficient was the system of internal policy established by this wise and great prince, that it is said, "if a gold bracelet were hung up in a place where four ways met, no man dared to touch it."

The next arrangement was the union of a number of tithings for military defence, this was called a *wapentake*, or weapon-take. The feudal militia consisted of one hundred men out of every *wapentake*. This body, in the ruder period of the feudal system, under the Anglo-Saxon government, was a voluntary service; but under the Norman conqueror, William, when the system of feudalism assumed its full development, it was exchanged for the tenure of *knight-service*.

The third and final division of the land consisted of a certain number of *wapentakes*, and was called a shire (or scyre), or one complete share, which united all the tithings in each shire into one compact body, subject to the laws and regulations made by the

* A *hide* of land was variously estimated at from sixty to a hundred and twenty acres, and was equivalent to a *carucate*.

scyre-gemot, or shire-parliament. This was composed of the chief magistrates of the tithings, who represented the respective districts in all matters in which they were concerned.

Towards the close of the sixth century, when the Anglo-Saxons had fully established themselves in the kingdom, there arose another power, an *imperium in imperio,* which profited and strengthened itself by every change, civil or political, that took place from time to time, to the prejudice of every other class of society. Under the ancient order of things, the Druids held unbounded influence over the people. When the Romans came, the Druidical system yielded partially to that of the less gloomy influence of the thousand deities of that enterprising, but superstitious people. But neither of these, although they claimed a large share in the management of state affairs, appear to have attempted to appropriate to themselves, as a sacerdotal order, the lands of their devotees. It was otherwise when the monk Augustin, at the command of Pope Gregory I., at the close of the sixth century, came into Britain to establish the papal system. Received courteously by Ethelred, King of Kent, his mission was successful, and from that period the Church of Rome never relaxed its encroachment upon the landed property of the kingdom. Strengthening their power and influence by usurping a right, in virtue of their office, to a share in the legislature, they passed laws which forbade the alienation of the smallest portion of their property, under pain of the ban of the church here, and eternal damnation hereafter.

It is not denied that the immense landed property formerly held by the Church of Rome was in general let to the people on easy terms, or that the monks were better landlords than many of the barons, who cruelly oppressed their dependents. The lands, too, held by the monks, in their own occupation, were cultivated by themselves, and were more productive than those held by the laity. But that the system was injurious to the material interests of the kingdom, at the same time that it was made instrumental in fettering both body and mind, and thus placing barriers to the progress of enlightenment and knowledge, will not admit of a question.

The conquest of England by the Danes in 1013 made but little change in the laws of the country. A part of their own laws which were engrafted, like those of the Romans, upon the existing code, was submitted to, and adopted by, the national council. The difference, however, between the Anglo-Saxon and Danish codes consisted rather in the scales of mulcts and penalties for infractions of the laws, than in the framework of the laws themselves: nor was any great change in the form of government attempted. In fact, the Danes had but little time allowed them for establishing extensive alterations; for in 1066, upon the death of Edward the Confessor, the Norman William prevailed upon the Pope to confirm a supposed promise of the deceased King Edward to make him heir to the crown. Armed with this then formidable sanction, he fitted out a large fleet, and putting on board a numerous and well-appointed army, he crossed the channel and landed at Hastings, where he defeated and slew Harold, who had been elected to the sovereignty by the *wittena gemotte,* or great national council.

Whatever forbearance the Danes might have shown in not forcing their laws upon the British, no such weakness was exhibited by William. The lands of the barons who opposed him were wrested from them, and given to his Norman followers; and this was carried to a still greater extent, when shortly after his accession they revolted against him. Having overcome them, he put all the leaders to death, and confiscated their estates, which were also bestowed upon his warriors. Earl Morton thus became possessed of 793 manors; Hugh de Alrinsis obtained the whole palatinate of Chester; Allen, Earl of Brittany, 442 manors; Odo, Bishop of Bayeux, 493; William, Earl Warren, 228, besides 28 towns or hamlets in Yorkshire; and the large county of Norfolk was divided amongst only 66 proprietors. The owners of these large properties resided almost entirely upon them, except when engaged in war, and usually held the land in their own occupation. The elder Spenser, in a petition to parliament about the year 1580, complaining of outrages upon his property, states his movable effects to be 28,000 sheep, 1,000 oxen, 1,000 cows, 500 cart horses, 2,000 hogs, 600 bacons, 80 carcasses of beef, and 600 sheep in the larder, 10 tons of cider, and arms for 200 men. This will afford a good idea of the households kept up in the baronial halls, and the large tracts of land necessary to support them.*

The practice of *sub-infeudation*† was greatly extended, and gave rise to the manorial system. The term *manerius*, or *manerium*, is derived from the Latin word *manire* and the French *manoir*, and denotes a large mansion or dwelling. In the Exchequer Doomsday Book it is called a *manerium*, and in that of Exeter a *mansio*, both being equivalent to the Anglo-Saxon or French term used by the officers who made the survey. It is, however, to be observed that the characteristics of the English manor were never prevalent enough in France to demand a specific designation.

A manor is commonly composed of *demesnes* and *services*. The demesnes are those lands within the manor, of which the lord is seized or possessed, *i. e.* of which he has the freehold, whether they are in his own occupation, or that of his tenants-at-will, or his tenants-for-years. The services of a manor are the quit-rents and other services due from freehold tenants holding of the manor. These services are annexed with, or appendant to, the seigniory over the lands holden by such freehold tenants. These lands, however, although thus far holden of the manor, are not *within*, or parcel of it, though within the lord's fee or manorial seigniory. At the present time, a manor rather signifies a jurisdiction or royalty *incorporeal*, than the land and suit; for a man may now have a manor *in gross*, that is, the right and interest of a court baron with its perquisites, whilst others possess and enjoy every foot of land belonging to it. In general, however, a manor may be composed of divers things, as a mansion, arable land, pasture, meadow, woodland, suit, advowson, court baron, &c., as possessed by the lords from time immemorial.

* Dugdale's "Baronetage," and Hume, vol. ii. p. 155.

† "Sub-infeudation—a grant of land on feudal conditions to an inferior tenant, by a person holding it himself upon like conditions of a superior lord."—See Webster. It was, in fact, similar to the sub-letting by middlemen in Ireland the condition in the latter being a money payment instead of feudal service.

SECTION II.

THE NATURE AND ORIGIN OF FREEHOLDS, COPYHOLDS, LEASEHOLDS, TENANTS-AT-WILL.—TENURE OF LAND IN IRELAND.—TENANT-RIGHT.

A FREEHOLD, or frank tenement (*librum tenementum,* in law), is an estate held for life, or some uncertain period, and of which the possessor cannot legally be deprived under ordinary circumstances. As we have already seen, it was by slow degrees amongst the ancient nations of Germany that the land became allodial, or freehold; merging thus from being the property of a tribe, for the common purposes and support of the community, to that of individuals. Amongst the Franks this word was sometimes restricted to such lands as had descended by inheritance. These were subject to no burthens except that of public defence. They passed to all the children equally, or in their failure, to the nearest kindred.

In England, during the middle ages, when the people were struggling for that freedom which we now enjoy, confiscations for rebellion against the reigning sovereign were of frequent occurrence, and in some instances to an enormous extent. These wholesale *escheats* afforded the monarch opportunities for enriching those who steadily adhered to his cause. Thus, as Hallam asserts, "In twenty years from the time of William the Conqueror's accession, almost the whole soil of England was confiscated and divided amongst foreigners, and very few of the original owners were left in possession as vassals of the Norman barons."

Besides the allodial lands distributed among the people, others were reserved to the crown; partly to support its dignity, and partly for the exercise of its munificence. These were called "fiscal lands," and formed the most regular and certain source of revenue to the sovereign. They were, however, generally granted out to favourite subjects, under the title of *benefices,* the nature of which is one of the most important points in the policy of those ages. It is probable that *benefices* were most frequently bestowed upon the professed courtiers,—the *antrustiones* or *leudes,*—and upon the provincial governors. It does not appear that any conditions of military service were expressly annexed to these grants, but it was expected that those who were the recipients of them would support the monarch in his wars, whether domestic or foreign. Beneficiary tenants were more closely connected with the crown than the mere allodial proprietors; and whoever possessed a benefice was considered bound to serve the sovereign in the field. But of the allodial proprietors, only the owners of "three *mansi*," or manors, were called upon for service.

By the law of England the possession of the land constitutes a freehold; and such estate as requires actual possession of the land, and no other, is, legally speaking, freehold; which actual possession can, by the course of common law, be only given by the ceremony called "livery of seisin," which is the same as the feudal investiture.

The ancient grants of land were frequently comprehended and expressed in few words in the deeds of gift, and many of them display a whimsical turn for jesting in those by whom they were drawn up. A grant of a large estate in Bedfordshire to the Burgoyne family was worded in the following quaint rhyme:—

"I, John of Gaunt,
Do give and do graunt,
To Roger Burgoyne,
And the heirs of his line,
Sutton and Potton,
Until the world's rotten."

The following is a still more ancient deed of gift by a Saxon monarch:—

"I, King Athelstane,
Do give to Paullane,
Odiham
and Rodiham.
Als guid, and als fayre,
Als ever yay mine wayre,
And yarto witnesse Malde, my wife."

William the Conqueror too, or his lawyers, aimed at rhymes in their deeds of gift. He gave one of his Norman followers,

"The hunter, the hop, and the hoptown,
With all the hounds, upside and down;
And in witnesse thereof that it was sooth,
He bit the wax with his fong tooth."

We have spoken of the English manor as signifying a mansion-house, the residence of the lord of the surrounding lands, which were originally granted by the king for special military or other services. Some were also granted by the superior lords on similar conditions, with the payment of such fees as by the grant were required. The grantees of the manors subdivided their lands and let them to inferior tenants, receiving in their turn rent and service from them. The superior lords, under whom the smaller manors continued to be held, were called in such cases, "the lords paramount" over all these manors, and his seigniory is to this day, in some cases, called an "honor," not a manor, especially if it has belonged to an ancient feudal barony, or has been at any time in the hands of the crown. The sudivision, or *sub-infeudation*, by the inferior lords, was carried to such a pitch, that at length the superior lords interfered, as they thereby lost their feudal profits on wardships, marriages, and escheats, which were monopolised by the mesne, or middle lords, who were the immediate superiors of the *terre tenants*, or occupiers of the land; and also because the mesne lords themselves were so impoverished thereby, that they were disabled from performing their services to their own superiors. Provision was therefore made in the 32nd chapter of the Magna Charta of the 9th Henry III. (not being found in the first charter granted by that king, nor in the great charter of King John), that no man should either "sell or give his land without reserving sufficient to answer the demands of the lord paramount;" and also in the statute of Westminster 3, or *Quia Emptores*, 18 Edward I., c. 1, which directs that "in all sales or feoffments of lands, the feoffee shall hold the same, not of his own immediate feoffor, but of the chief lord of the fee, of whom such feoffor held it." But these provisions not extending to the king's own tenants *in capite*, the like law is declared by the statutes of *Prerogativa Regis*, 17th Edward II., c. 6, and by the 34th Edward III., c. xv.; by which last, *all the sub-infeodations previous to the reign of Edward I. were confirmed, but all subsequent to that period were left open to the king's prerogative.* Hence it is clear, that all manors existing at this time must have existed as early as Edward I., for it is essential to a manor that there be tenants who hold of the lord. And by the operation of these statutes, no tenant *in capite* since the accession of that prince, and no tenant of the common lord since the statute of *Quia Emptores*, could create any more tenants to hold of himself.

A manor is necessarily a freehold tenure in itself; but it is the origin of the copyhold tenure, for which the possessor has nothing to show but the copy of the roll, made by the steward of the lord's court. In this respect, however, the title is more valid than those of some freeholds, which, in passing through many hands, may, through the negligence or ignorance of the lawyers, be damnified by the omission of a name,* &c.; whereas on every change of hands of a copyhold estate, it must necessarily be taken up, and the fines paid at the customary court; and thus the transactions of the manor-court become a historical and reiterated testimony to the validity of the title. The steward of the court for the time being is bound to keep and enrol a register of the tenants who are admitted to any parcel of land, or tenements belonging to the manor; and the transcript which each tenant can demand of his own title is called "the copy of the court-roll." Copyhold is called *base tenure*, because the tenant holds apparently at the will of the lord. Fitzherbert says, it was formerly called "tenure on villeinage," and that copyhold is but a modern name.

This was the land which the Saxons termed *folk-land*, as being held *sine scripta*, in contradistinction to *book-land*, or charter land, "*terre-ex-scripta*," now called freehold. But the distinction is not now strictly correct, because copyhold is not held simply at the will of the lord, but according to the custom of the county or the manor; nor is it held absolutely *sine scripta*, for the possessor holds a title in the "copy of the court-roll," which the lord cannot annul, provided the tenant fulfils his part of the service. It is true that copyholds originated in a series of immemorial encroachments on the

* The writer once purchased a freehold property which had been sold long before under the Bankruptcy Court, and by some strange negligence of the solicitors, both of the sellers and purchaser, the names of the assignees were not appended to the sale! Twenty years had elapsed, and only one of the assignees had survived, and he had gone, no one knew where. After lengthened inquiries, his residence was discovered, and his signature obtained. But it cost the lawyers who made the blunder—and who were, as honourable men, quite ready to take the onus upon themselves—much time, trouble, and money to rectify it.

lord, by which the intruders at length established a "customary right to those estates which previously were held absolutely at the will of the lord." To this cause is ascribed by lawyers the different customs prevailing in different manors, with respect both to the descent of the estates and the privileges belonging to the tenants. This "custom of the manor" is called "the life of copyhold estates;" for without a custom, or if a copyholder breaks the customs, he is then subject to the will of the lord; and as a copyhold is created by custom, it is also guided by custom. A copyholder who performs his services, and does not break the custom of the manor, cannot be ejected by the lord; if he be, he shall have trespass against him. Nor can the lord refuse to admit; for if he does, he can be compelled in the Court of Chancery.

In some manors, where it has been the custom to permit the heir to succeed the ancestor in his tenure, the estates are called "copyholds of inheritance." In others, where the lords have been more vigilant in the maintenance of their rights, they remain "copyholds for life" only. The custom of the manor has, in both instances, so far superseded the will of the lord that, provided the service be performed, or stipulated for by fealty, he cannot in the first instance refuse to admit the heir of his tenant upon his death; nor, in the second place, can he remove his present tenant so long as he lives, though he holds nominally by the precarious tenure of his lord's will. And if a lord refuse to admit a surrender on account of a disagreement about the fine to be paid, the Court of B. R.* will grant a mandamus to compel him to admit, without examining the right to fine. But that court will not grant a mandamus to admit a copyholder by descent, because, without admittances, he has a complete title against all but the lord. Copyholds descend according to the rules and maxims of the common law (unless in particular manors there are contrary customs of great antiquity); but under the ancient law, such customary inheritances are not assets to charge the heir in actions of debt, &c., though leases for one year of copyhold land, which are warranted by the common law, are assets in the hands of an executor. There may be an estate-tail in copyhold lands by custom, with the co-operation of the statutes of William II.; and as a copyhold may be entailed by custom, so by custom the entail may be cut off by surrender. A copyholder cannot convey or transfer his copyhold to another otherwise than by surrender at the general court-baron of the manor.

Copyholds are held by *fine certain* or *fine arbitrary*. *Fine certain* is when the fine payable to the lord upon taking up an estate, being fixed by the custom of the manor, cannot be increased by the lord, who, upon the amount being paid and the services performed, must admit the new tenant. *Fine arbitrary* is when the fine is only limited in amount by the lord's own conscience, which is not usually of a very tender kind.†

One of the ancient obligations of a copyhold tenant was that of grinding at the lord's, or manor mill. In ancient records, mills are spoken of as valuable property; and landlords, in letting the rest of their land, generally reserved the mill-house to themselves, it being frequently appended to the great mansion or manor-house. The following is the account of a mill-house in Barnaby Goodge's "Foure Books of Husbandrie:"—"When as in a great house there is greate neede of corn-mylles, and the common mylles being farre off, the way foule, and I at my owne libertie to grind at

* *Bancus Regius*, or King's Bench.

† The writer once purchased a small copyhold property under *fine arbitrary*, and the steward managed to make the fine and expenses amount to 80 per cent. of the purchase-money of the property.

home, or when I lyste, thinking to make a mylle here at home, where neither place nor auethoritie will serve me to build either a water-mylle or wynde-mylle, and a *querne*, or hande-mylle, doeth but a little goode, and to build a horse-mylle were troublesome; when I saw the wheeles which they used to draw water with, turned with asses or men, I thought in the like sort, the wheele of a mylle might be turned. And after this sort, I divised this engine, which a couple of asses, guided by a boy, do easily turn, and make very fine meale, sufficient for mine owne house, and most times for my neighbours, whom I suffer to grind free of toll."

The word *lease* is derived from the French *laisser*, to let. In law, a demise or a letting of lands, tenements, or hereditaments unto another for life, a term of years, or at will, for a rent reserved.

A contract for the possession of land, &c., for some determinate period is "an estate for years." If the lease be for one year, half a year, or a quarter, or any less time, the lessee is reputed a "tenant for years," and is so styled in some proceedings, because a year is the shortest term the law takes notice of in this case. A lease *for twelve months* is only for forty-eight weeks, but if it be *for a twelvemonth*, in the singular number, it is good for the whole year. These leases or estates for years were originally granted to mere farmers or husbandmen, who every year rendered some equivalent in money, provisions, or other rent to the lessors or landlords. But, in order to encourage them to cultivate and manure the land, they had a permanent interest in it granted them, not determinable at the will of the lord. Their possession, however, was considered of so little consequence, that they were looked upon rather as the bailiffs or servants of the proprietors, and were to account to them for the profits at a fixed price, than as having any property of their own, and, therefore, they were not allowed to have a freehold estate in it. But their interest existed after their deaths in their executors, who were to make up the accounts of their estates with the lord and his other creditors, and were entitled to the stock upon the farm.*

The question of the necessity of leases, and of their advantages to both landlords and tenants has been well ventilated of late years, and is well understood by most persons conversant with farming upon the modern system, and no liberal or enlightened landlord refuses to grant leases to his tenants; nor will any improving tenant entrust his property, by expending it in the *necessary permanent improvements* on a farm, from which the caprice, or the cupidity, of the landlord might eject him at six months' notice without a shilling remuneration. The danger of such a dismissal is no imaginary one, instances of it being of too frequent occurrence in the country. A recent case in a northern county—in which one of the best farmers in England, and whose family had occupied the farm for many years, was thus summarily ejected without the whisper of a complaint of his conduct, either in the management of his farm, or his conduct to his *noble* landlord, and after expending a great part of his property in permanent improvements—is sufficient to open the eyes of the farmers to the danger. It was a melancholy satisfaction to the tenant, after being thus plundered of his property, that his neighbours have testified their sense, both of the excellence of his character and of the unjust and mean conduct of his landlord, by presenting him with a valuable and hand-

* It is proper to state that the legal arguments and definitions in the foregoing account of the different tenures are derived from various sources, but chiefly from Rees' "Encyclopædia," which contains the clearest digest extant of the laws on the subject.

some testimonial, in token of their respect and esteem. His unworthy landlord has shown the motives which actuated him by letting the land to a new tenant at an advanced rent.

Lord Kames, in his "Gentleman Farmer," has strongly insisted on the necessity of a long lease (nineteen or thirty-eight years) to secure the tenant in his possession, and enable him safely to effect those improvements that will at once both benefit the estate and afford him the opportunity of deriving the greatest profit from his capital. The heads of a lease on a liberal plan are given in the work; and the Board of Agriculture, which was established in 1793 (about seventeen years after the publication of Lord Kames' book), adopted most of the principles laid down by him. There may be landlords who, while hesitating or refusing to grant leases to their tenants, under the apprehension that it is giving up too much power over their property, who yet are too honourable, and would, therefore, scorn to take an unfair advantage of a good and improving tenant by robbing him of his property, and his future profits upon the outlay. Independent of this, the impolicy of the system is as apparent as its injustice. Good landlords do not live for ever; and it is unjust to hold a tenant at arm's length, and allow him to expend his property on the land upon the precarious tenure of his own life, when he does not know but that his successor may be a man of a very different disposition, and disposed to take every advantage of his tenants. We have no hesitation in saying that, if the predecessors of Mr. W.'s late landlord had acted upon the same principle in dealing with their tenants, the estate would not be now worth half its present value. The only *safe* plan that the present holder of the land can pursue, is to avail himself of Mr. W.'s improvements, and get as much out of the land as possible without expending a shilling upon it in improvements, the profits of which he would probably be deprived of by an ejectment, to make room for another tenant at a farther advance of rent—the landlord's profit upon his outlay.

Any man conversant with rural affairs is able to judge, as he rides along the high roads, of the nature of the tenure by which the land is held. He has nothing to do but to look over the hedges to determine whether the land is held on lease or at-will. It is astonishing that the owners of land cannot see, by the different appearance of the fields, the impolicy of preventing the tenants from improving their farms by making it unsafe for them to do so. The interests of landlords and tenants are inseparable, and one cannot secure an undue advantage over the other. A good landlord will have, as a rule, good tenants; and *vice versa*. It is unfortunately the case that many landlords are governed more by their stewards, or land agents, than by the principles of equity in their dealings with their tenants. These gentlemen have many of them a keen eye to their own emolument, and too often set a black mark against those tenants who display any independence of mind, and will not submit to their extortions.*

Lord Kames justly observes that in a lease of a corn-farm the object in view should be to restrain the tenant from impoverishing the land, and yet leave him at liberty to improve it. He compares a tenant with a British monarch, who has unbounded power

* The late Earl of B. employed one of these legal sharks. "I am surprised," said his countess to him on one occasion, when he had sharply lectured his steward for some peculations,—"I am surprised, my lord, that you keep that man in your employ, when you know he is robbing you every day of your life." "True, my lady," was the reply, "I know he is a thief, but I also know that he takes good care my tenants shall not rob me. Better to have one rogue to deal with than one hundred and fifty."

to do good, none to do mischief. He declaims against tying a tenant down to an invariable course of cropping, which must be regulated by the season, the variableness of which may, for one year, at least, necessitate a change in an otherwise well arranged system. And although many good tenants may be trusted with unlimited scope in the management of their land, a landlord cannot, as a general rule, tell the disposition of a tenant in this respect beforehand; and, therefore, it is proper that a decided, but liberal code of covenants should in all cases be adopted to secure both the landlord and a profitable cultivation.

The value and importance of granting suitable and long leases is sufficiently exemplified by the results on those estates on which it is the practice. Any man, for instance, in passing through the county of Norfolk, where long leases, *as a rule*, prevail, will be struck both with the high state of cultivation which the fields present, and the wealth, ease, and independence of the occupiers. Perhaps the Holkham property is an exceptional case, the farms being in general very large, and the tenants unusually wealthy. The farm-houses are more like gentlemen's seats than the dwellings of husbandmen, and the fields are many of them large enough to constitute a good sized farm. But it may be safely assumed that the highly prosperous condition of the Holkham estate, which has increased three or four times in value since the late proprietor succeeded to it, is entirely owing to the liberal principle on which he acted in letting his farms, and the twenty-one years' leases on which they were invariably held. The policy of this was proved by the result; for, probably, there is not a landlord in the kingdom who has had less trouble with his tenants, or whose tenants have more cheerfully, at the expiration of their leases, agreed to pay the advanced rent which the diminished value of money rendered reasonable.

The Earl of Yarborough's property in Lincolnshire is another instance in point. Following the example of the "Holkham chieftain," he has increased its value from £3,000 to £30,000 a year. Most of the farms in Lincolnshire are large; and although the custom of the county has generally been against leases, the lands being held from year to year, a tacit understanding exists between landlord and tenant, which is seldom broken. We may also mention the Duke of Bedford's estate at Woburn as a proof of the advantage of granting leases. The late Francis Duke of Bedford was the friend and coadjutor of Mr. Coke, afterwards Earl of Leicester, and adopted his system in every respect. His unfortunate death in 1801,* put a stop to many of the more public measures which he adopted for the improvement of agriculture. But although his immediate successor did not profess himself an agriculturist, he pursued the same liberal course with his tenantry, and the present proprietor follows in their steps. The consequence is, the estate has increased in value until it realises £100,000 a year. The present duke, indeed, is a model for landlords to copy from. When agriculture had reached a certain crisis, he instituted a valuation of his property, and offered fresh terms to his tenants, to which they readily acceded. He also erected comfortable cottages for the labourers on every part of the estate, with gardens attached, and established schools for their children, and other means of instruction. On the other hand, he has undertaken the expense of permanent improvements, such as drainage and other substantial works, for which the tenant willingly pays a moderate per centage. But the most remarkable

* The duke was killed in playing at tennis. The ball struck him on a part that was ruptured, which increased the wound, produced mortification, and carried him off in a few days

concession to the welfare of his tenantry is, his abandoning the excessive preservation of game, and the absurd and un-English *battue*—a German innovation, which in this highly cultivated country is as senseless and puerile as shooting fowls in a barn-yard, to which it bears a striking resemblance. As we shall have occasion to refer to this silly practice when treating on the Game Laws, we shall say no more about it at present.

It is in Scotland that the practice of granting leases has received the greatest extension, and in no part of the United Kingdom has the benefit been more clearly developed. Agriculture in that country cannot be said to have existed more than a century, for previous to the year 1770 cultivation was conducted on the most primitive plan. Yet, with very inadequate means, but with steady economy, prudence, and perseverance, and with the aid of an excellent system of banking, Scotland has progressed in agriculture faster than England. These advantages, however, would have availed nothing but for the system of leases on liberal terms, which, by inspiring the occupier with confidence, enabled him to prosecute his calling with spirit and success. Most of the leases are granted upon a corn-rent. "Under this system the rent is represented by a payment in kind, converted at the market price, with a maximum and minimum limitation for periods of scarcity or abundance."* In this way the farmer is protected against sudden fluctuations in the value of his commodities, as well as in that of money. "The usual term for renewing leases is Whitsuntide, as being the most favourable period to prepare for the crops of a new course."† Scotch leases are generally granted for nineteen years, and a lease is considered *real* property, and as such passes to the heir-at-law. This is an injustice to the younger branches of the family, being equal to an entail; but, at the same time, it prevents that subdivision of the land which in Ireland produces frequent famines, and in France and other countries of the Continent has prevented progress in agriculture.

Every estate which must expire at a period certain and prefixed, by whatever words enacted, is an estate for years, and therefore this estate is called a *term,—terminus,—* because its duration is limited and determined; for every such estate must have a certain beginning, and a certain ending. A lease for so many years as a man may live is void from the beginning, but a lease for twenty or more years, if he shall live so long, is good; for a certain period is fixed, beyond which it cannot last, though it may be determined sooner by the person's death. An estate for life is a freehold; but an estate for a thousand years is only a chattel, and is reckoned part of the personal estate.

Estate-at-will.—This is another kind of estate not freehold, where lands are let by one man to another "to have and to hold" at the will of the lessor; and the tenant by force of this lease obtains possession. Every estate-at-will is at the will of both parties, landlord and tenant, so that either of them may determine his will, and quit his connection with the other at his own pleasure.

A lease in writing, though not under seal, cannot be put in evidence unless it be stamped. Leases exceeding three years must be made in writing; and if the substance of a lease be put in writing and signed by the parties, though it is not sealed, it shall have the effect of a lease for years. Articles with covenants to make a lease, to let and make a lease of lands for a certain term, at so much rent, hath been adjudged a lease. In a covenant with the words "have, possess, and occupy lands in consideration of a yearly rent," without the word "demise," it was held a good lease; and a licence "to

* De Lavergne. † Ibid.

occupy, take the profits," &c., which passeth an interest, amounts to a lease. An agreement of the parties that the lessee should enjoy the lands will make a lease; but if the agreement hath a reference to the lease to be made, and implies an interest not to be perfected till then, it is not a perfect lease till made afterwards. If a man, on promise of a lease to be made to him, lays out money on the premises, he shall oblige the lessor afterwards to make the lease, the agreement being executed on the lessee's part; where no such expense hath been, a bare promise of a lease for a term of years, though the lessee hath possession, shall not be good without some writing. A lease for years may begin from a day past or to come, at Michaelmas last, Christmas next, three or four years after, or after the death of the lessee, &c., though a term cannot commence upon a contingency which depends upon another contingency. If one makes a lease for a year, and so from year to year, it is a lease *for two years*, and afterwards it is but an estate-at-will; and if from three years to three years, it is a good lease for six years.

Tenancies-at-will, or until the customary notice be given by either party to the other, are valid without any written contract or agreement, the only tie between the parties being the custom of the estate or of the county in which it lies, or the common law of the land. This, Marshall conceives, may be considered as the "simple holding which succeeded the feudal or copyhold tenure," but which is now going fast into disuse. A second mode is, of "holding from year to year, under a written agreement, with specific covenants." This, which is a more modern usage, is, on the contrary, becoming more and more prevalent, even where leases for a term of years were formerly granted. A third is, a lease for a term of years, as seven, fourteen, twenty-one, or a greater number of years certain, but without the power of assignment, unless with the consent of the lessor. A fourth is, a lease-for-lives, as one, two, three, or more lives, without the power of assignment. These are rarely granted in England, but are common in Wales and Ireland, the rent being there settled according to the value of the land at the time of letting, as on granting a lease for a term. In the western extremity of England, what are termed life-leases are still common; but they are, in fact, rather pledges for money taken up, or deeds of sale for lives, than leases, as nearly the whole estimated value of the land during the life-term is paid down at the time of purchase, the seller reserving only a quit-rent, or annual acknowledgment.

"It is a well-authenticated fact," says a modern writer, "that the great and manifold improvements which have taken place in agriculture are in those counties where leases for a term of years have been granted."*

Tenure of Land in Ireland.—The peculiar nature of the landed property in Ireland deserves a passing notice, although, in consequence of the operations of the Encumbered Estates Court, the old system is fast dying out, and a new order of things is succeeding it.

It is well known that in the various rebellions in that country,—for rebellion was formerly its normal condition,—a very large portion of the land was wrested from the proprietors and bestowed upon the favourites of the reigning monarchs, or sold for a sum of money. Thus the Ironmongers' Company obtained by purchase a whole county, which was ceded to it by James I., who confiscated six counties at once, and parcelled them out amongst his favourites. Charles I. declared the whole province of

* The single exception to this rule is a part of Lincolnshire, where yearly tenancy is the rule; but a tenant-right exists, by which an outgoing tenant is indemnified.

Connaught the property of the crown; and Cromwell seized and appropriated the lands of the other provinces. Ulster was made a plantation for a Scotch colony, and the dispossessed Irish were ordered to go "to hell or Connaught." The object of every government, from that of the Tudors to the accession of William III., had the same end in view, of preventing the Irish from holding land in their own country.

Nearly all the landed property of Ireland was entailed, consequently improvement was checked at the outset; for the owners, being generally poor, would not expend money on improvements by which their heirs-at-law alone would reap the benefit. But the great evil of the land system in Ireland was the absenteeism of the proprietors, who entrusting the management of their estates to lawyers, cared little about their tenantry, provided they received the rental, which they spent in England or on the Continent. The land was let to a large extent to middle-men, generally on a lease, who being anxious to make the most of it, underlet it in small farms to the peasantry at high rents. These built their hovels upon the land, and cultivated the potato as the most productive plant for human food.

The Irish landlord of bygone times was a remarkable character in his way. Reckless extravagance marked his conduct, and, provided he could obtain money, cared little how it came, or where from, or by what means it was made away with.

Tenant-right.—If the arguments we have used to prove that land, as a national property, is in all cases vested in the crown as the custodian for the common weal, and that private interest must, in law and in equity, give way to the public good, then the legislature is bound to interfere to prevent the land from deterioration on the one hand, and to promote, by wise and equitable general measures, its improvement.

We have endeavoured to show that the want of leases is the direct and chief cause of the land of England not being properly cultivated; that no tenant-at-will can have any inducement to expend money in permanent, or, in fact, any improvement whatever, of which his landlord may, and frequently does, deprive him, allowing him no time for reaping any benefit from his outlay.

As a national affair, this was formerly of no apparent consequence; because, badly as the land was cultivated, and inadequate as was the produce, compared with what it might have been, it usually exceeded the consumption both of man and beast; and therefore the injury being limited to a restriction of the exporting power, it was less palpable, except in seasons of scarcity, when the deficiency was ascribed to a bad and unproductive harvest. But now that, in consequence of the vast increase of the population, and the improved condition of the operative classes, the consumption has so prodigiously increased as to require, in the present state of agriculture, an importation of agricultural produce (animal and vegetable) amounting on an average to not less than £20,000,000 sterling per year, it behoves the government or the legislature to devise means for preventing, as far as possible, this enormous expenditure from increasing, which it certainly will, unless measures are adopted for rendering the land more productive.

Under the present system of the tenure of land, this can only be done by passing an equitable and liberal law for establishing a system of tenant-right, which whilst it would give to the landlord the full value of any improved outlay the outgoing tenant may justly claim, the latter may fearlessly incur that expenditure without the risk of being deprived of it by a summary dismissal from his farm.

Whilst this principle applies with greatest force to the position of the tenant-at-will, in a national point of view, it is to a certain, though lesser extent, applicable to all tenures; because it is a well-known practice with tenants on leases for years, or of whatever duration, if intending or compelled to quit their farms, to run the land the last three or four years of the term, or at least to put nothing into it; consequently, the productiveness of such land is for the time greatly deteriorated, and the landlord, the succeeding tenant, and the community at large, are mutual sufferers.

It is now become a universal opinion that the lands of England, whatever advances may have been already made in agriculture, are far, *very far*, from having reached the maximum of production; that, in fact, if they were properly cultivated, we should be an exporting instead of an importing country. Many causes exist to prevent this from being the case, but the chief ruling cause is that the landed proprietors steadily refuse to allow the legislature to interfere with their property, the welfare of the country at large being a matter of secondary or no importance compared with retaining their rights intact. The question, however, will force itself upon the government before long, for in a year of scarcity the consequences are serious. In the last year (1860), for instance, the deficiency was so large that it will require importations altogether to the value of nearer £30,000,000* than £20,000,000—a sum sufficient to throw the finances of the country into a state of confusion.

That an equitable *tenant-right*, giving the occupier of land, on whatever tenure, at the close of his occupancy, a legal title to the remaining value of his improvements and outlay, would do more for the advancement of agriculture and the increase of the productiveness of the land than any other measure, no one will entertain a doubt who has ever considered the subject. Whilst the light lands of Norfolk and Suffolk are made to produce from four to six quarters of wheat per acre, immense tracts of far superior soils do not produce more than half that amount, simply because the tenure of land is so precarious that the occupier has no inducement to improve it. It is probable that fully three-fourths of the land of the country is in this condition, and will continue in the same state so long as the proprietors claim the right of "doing what they like with their own."

The question of tenant-right has been long and amply discussed in Ireland, where an association, or *league*, exists for procuring a legislative enactment for its general establishment. Such an act is even more required in that country than in England, although the changes which have recently been effected in the proprietorship of land have, to a considerable extent, altered the condition of real property. As on all subjects, whether political or social, taken up by the Irish, the ideas entertained by some of the leaders in the movement were most extravagant, and amounted rather to a surrender of the freehold to the tenant, than an equitable claim for compensation at the expiration of the lease. *Fixity of tenure* was combined with a reduction of rent to the minimum value of *unimproved* or waste land, estimated by these revolutionists at 1*s.* 6*d.* per acre! This fixity of tenure was neither more nor less than an interminable lease, equal to an English copyhold, with a *fine certain* of 1*s.* 6*d.* per acre as a quit-rent; so that, could this object have been obtained, it would have amounted to a surrender of the land to the tenants without any remuneration to the proprietor, who was looked upon and verbally treated as an interloper and a tyrant.

* Ten million quarters of wheat and flour, at 50*s.* per quarter, £25,000,000; and barley, oats, beans, peas, potatoes, and cattle, to the amount of more than the remaining £5,000,000.

True enough it is that the tenure of land in Ireland was of a nature to render a change a national necessity, in order to avert the normal tendency to famine and scarcity which, up to 1848, prevailed there. A large portion of the soil was in the hands of middle-men (the owners being absentees), whose object was, as a rule, to make the most out of the property, while their lease lasted, without any regard to the mode in which the land was cultivated. It was therefore let in small holdings, as the means best calculated to effect their purpose, and the overwhelming excess of the rural population* was favourable to it. Thus the greater part of the country was in the hands of the most ignorant class of cultivators, without means or knowledge to effect improvements, and deriving from the land a scanty supply of potatoes and oats for their own families. The larger farms are sometimes let on lease; but the proprietor gives himself no trouble, and will, in general, incur no expense in the erection of dwelling-houses or out-buildings; the consequence is, that the majority of farm-buildings are such as no Englishman would put up with, whilst the cabins of the humbler tenantry were not fit for human beings to reside in, being in many cases built with loose stones, without cement, against the side of a bank or hill, which formed one wall of the dwelling.

It is evident that nothing but a compulsory law, giving the tenant a claim at the close of his lease for any improvements effected either in the land or the buildings of a farm, would produce any change in this state of things. The people of Ireland were therefore perfectly justified in demanding a tenant-right law; and had they not in the first instance extended their demand to fixity of tenure, and what may be called an abrogation of rent, it is probable they might have obtained what was absolutely required. But, listening to incendiary demagogues, they claimed a right to the soil, and, consequently, gained nothing.

In the province of Ulster tenant-right has long been established by custom, and if we may judge by the different state of agriculture in that province from any other part of Ireland, it has certainly worked well, and prevented that deterioration of the soil which was everywhere else apparent. Such however was the demand for land, that the claim for compensation upon the transfer of a lease was in some instances most extraordinary. As much as from £15 to £20 per acre has been given for leases of small farms, without reference to any material improvements. Nor can this be considered extravagant in a country where lands were let on the con-acre system,† as high as *thirty pounds per acre* per annum, and when the lowest rent upon that tenure was £10 per acre. It is not to be supposed, however, that either these enormous rents were always punctually paid, or that the tenants were able to live out of the produce of the land. On the contrary, the payment of the rent was dependent on the contingency of a good crop, and the support of the tenant and his family upon the same, with the additional chance of obtaining harvest work in England. The great catastrophe of 1846 revealed the entire rottenness of the land system in Ireland, and the fallacy of the claim of the nominal proprietors of the estates called by their names. The Encumbered Estates Court with ruthless hand completed the exposure, and the results of its operations have vindicated the conduct of the legislature in its institution.

* In Ireland the rural population amounted, before the famine, to 25 to the hundred acres; in France, to 16; England, 12; and the Lowlands of Scotland, 5 to the hundred acres.

† *Con-acre tenure* is the letting of a piece of land well manured to a tenant for one year, generally for the purpose of raising potatoes. The rent ranged from £10 to £30 per acre, according to the quality and condition of the land. This system was abolished by the famine of 1846-8.

Tenant-right, however, is not unknown in England, for in two counties, Lincolnshire and the Weald of Sussex, it has long been established by custom. In the former it has worked well, for no part of England is better cultivated, or more productive, although yearly tenures are the rule. In the Weald of Sussex agriculture is far from being in a flourishing condition, but this is in spite of the tenant-right, and not in consequence of it. If we may judge from analogy, the state of that district would be still worse without it. Sussex is perhaps, in some parts, one of the most difficult counties in England to farm. In a dry season the soil is iron and brass; and in a wet one, a mass of adhesive mud. A rental of from 4*s.* to 6*s.* per acre explains the whole case.

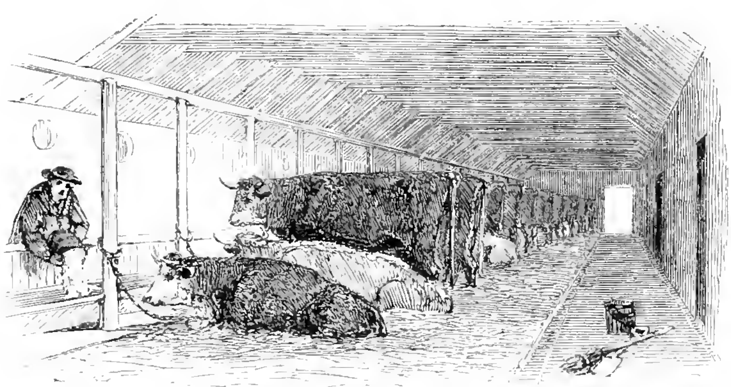
The objection urged against tenant-right is, that it renders an in-coming tenant—possibly a young man just starting in life—liable to a heavy claim* that will absorb a large portion of his capital, with which he ought to stock his farm; and that it opens a door for fraud, by "inducing the farmer to look more to the indemnity he claims on leaving his farm, than to good farming while in possession."†

There is certainly truth in the objection that a young farmer would be compelled to pay a large portion of his capital in the purchase of the tenant-right, and thus cramp his future operations on the farm; but this will tell in favour of, as well as against, the system. It is surely better to step into an improved farm, with the land in a good—not to say high—state of cultivation, and which will afford an immediate profit, even if he has to pay for it, than into one which has been completely run out the last four or five years of the previous occupation, and will require quite as many more before it can be brought into a profitable condition. It would, however, be better perhaps if the landlord would pay the out-going tenant for the permanent improvements, such as draining, marling, claying, fencing, &c., and charge the in-coming tenant a fair per centage upon the outlay, as has been done by the Duke of Bedford and a few other liberal landlords.

Whether, therefore, we look at the just rights of the out-going tenant, the success of the in-coming one, the prosperity of the estate, or the well-being of the community, as all concerned in the proper cultivation of the soil, all their interests would be promoted by a tenant-right, which, while it would prevent the deterioration of the land at the expiration of a lease, would enable the tenant-at-will to farm on the system best adapted to promote his own advantage and the interests of all parties concerned.

* In Lincolnshire and Nottinghamshire the usual claim is £4 to £4 10*s.* per acre, and in Sussex from 30*s.* to 50*s.* per acre. The former is moderate, the latter "all the money too dear."

† De Lavergne.



SECTION III.

ON THE VALUE OF LAND AT DIFFERENT PERIODS, AND THE CAUSES WHICH OPERATE TO INCREASE OR DIMINISH IT.

It appears a strange thing to an English farmer to be told that there was a time when land in this country was sold at three or four shillings, and let at one halfpenny, an acre. Yet this is not more strange or extraordinary than that at the present time, excellent land may be purchased in the United States for a dollar an acre; and that in Canada any person may obtain a grant of two hundred acres of land for nothing, if he will only undertake to clear and cultivate it within a certain period.

There are various causes operating to affect the value of land: such as the relative proportion between the quantity of land and the number of inhabitants; the scarcity or abundance of money; the existence of good roads; the distance from markets, &c. The following particulars are extracted from Cullum's "Antiquities of Hawstead in Suffolk."

The parish of Hawstead is set down in the Doomsday Book at thirteen *carucates*, or 1,300 acres, of land, being eight furlongs in length and six in width. "In both these particulars," adds the learned historian, "it is wrong; it contains 2,000 acres, and if stated at double the length and breadth, it will be nearer its real dimensions."

By a survey taken the fourteenth of Edward I., it appears there were two manors in Hawstead, that of Fitz-Eustace being called "the Manor," which was valued at 40*s.* per annum.

In the same year seven persons held amongst them 968 acres of arable, and forty acres of meadow land; the rent paid ranged from 7*d.* to one farthing an acre a year, averaging about 4*d.* per acre.

In the seventh and eighth centuries the ordinary price of an acre of the best land in Cambridgeshire was sixteen Saxon pennies, or about 4*s.* of our money.

In the seventh of Henry V. (1420) the manor was said to be of the yearly value of £12 15*s.* 10*d.*, and half a pound of pepper. This last was paid for eleven acres of land.

"In the twenty-sixth of Henry VI. (1448) John Bokenham sold all his lands and tenements, woods, meads and pastures, rents and services, which were let to one John

Bokenham, brother unto the said John Bokenham, as they lie in the towns and fields of Hawstead, Horningshorthe, Newton, and Whipsted in the shire of Suffolke, for the sum of £cx (£110) good and lawful money, to John Marshall, Esquyer, reserving to himself and wife a life interest therein:" this last appears to have been a very large sale, although the number of acres is not stated.

Thomas France held a messuage and thirty acres of land, arable and pasture, at the yearly rent of 20*s.*, a Christmas offering of 4*d.*, cocks and hens, and to mow the lord's meadows three days, and have one bushel of wheat and 6*d.* for drink, and one day's produce of the dairy, and eight whole days in autumn reaping, having every day a wheaten loaf of fifteen to the bushel of wheat, and eleven herrings at nine o'clock. The said Thomas holds another messuage and fifteen acres of arable land, for which he pays 13*s.* a year.

About the thirteenth century, according to Fleta, if an acre of wheat yielded only three times the seed sown, the farmer would be a loser, unless corn should sell dear. Three ploughings 1*s.* 6*d.*, harrowing 1*d.*, two bushels of seed 1*s.*, weeding ½*d.*, reaping 5*d.*, carrying 3*d.*, in all 3*s.* 1½*d.*, which is more than six bushels of wheat by 1½*d.* The same year the price of a bullock was 8*s.* 6*d.*, a hog 2*s.* 6*d.*, a pig 6*d.*, threshing a quarter of wheat 3*d.*, of seligo 2½*d.*, barley 1½*d.*, peas 2*d.*, draget 1*d.*, oats 1*d.* A man's wages for cutting fire-wood two days, 4*d.*

In 1359 the lord of the principal manor held in his own hands fifty-seven acres of arable land, estimated at from 4*d.* to 8*d.* per acre, and eight pieces of meadow or mowing land, valued at 202*s.* 4*d.* a year, the quantities being about fifty acres; forty acres of wood at 1*s.* per acre, and the cropping of the trees and hedges at 6*s.* 8*d.* per year.

In 1420 eight acres of arable land were let at 6*d.* per acre; thirty-eight acres at 9*d.* The hay of an acre was worth 5*s.*

In 1491 the Abbot of Bury let eighteen acres of pasture to a man and his wife and their executors, for eighty years, at 6*s.* 8*d.* a year, or 4½*d.* per acre.

In 1500 the most valuable land was let at from 1*s.* 4*d.* to 1*s.* 6*d.* per acre. In the reign of Henry VIII. thirty-one and a half acres of arable land were let at 1*s.* per acre; thirty-four and a half of arable and four and a half of pasture for 40*s.*

In 1536 four acres of arable land let for 4*s.* a year, seven acres for 8*s.*, and Clopton's Close in Hawstead (twenty-five acres) for 20*s.* (now worth £20—1813).

Up to this period, although the discovery of Mexico had opened the gold and silver mines of that country to Europe, the jealousy of Spain of other nations prevented it from acting upon the value of property in England. But towards the close of the sixteenth century an active smuggling trade was maintained between England and the Spanish American colonies, which poured a mint of wealth into this country, the effects of which were soon apparent.

In 1572 thirty-nine acres were let for twenty-one years for £4 9*s.* a year, or 2*s.* 3*d.* per acre; and fourteen acres three roods were let for twenty-one years at £2 9*s.* 3*d.*, or 3*s.* 6*d.* per acre.

In 1600 Hawstead Hall or Manor-house and 126 acres of land were let to William Crofts, of Bury St. Edmunds, for eleven years for £40 and ten coombs of oats a year, or about 6*s.* 8*d.* per acre. In 1611 the dairy-house, a barn, garden, several utensils of household, the use of the brewing and baking-house, with four parcels of Hawstead

Park, containing together 155 acres, were let for three years for £85 5*s.* a year, which is near 11*s.* per acre.

In 1616 a survey of the manor was taken, and the demesne lands, consisting of 366¾ acres of arable and pasture land, and thirty-eight and three quarter acres of meadow, in all 405½ acres, were valued at £249 a year, or 12*s.* per acre; thirty-nine and a half acres of wood at £12, or 6*s.* per acre.

We shall now turn to another part of the country. In Bartlett's "Antiquities of Manecester," in Warwickshire, we find the following notices:—

"The manor of Ansley in that parish was valued in Doomsday at 100*s.* In 1791 it was sold for £3,000.

"In the reign of Henry V. (about 1420) the manor of Wynfield, containing 2,000 acres, was valued at £7 9*s.* 11*d.* per annum beyond reprises. In 1684 it was let at £250; and in 1791 it was again let on lease for twenty-one years, at £1,500 or 15*s.* per acre per annum."

This last entry is a complete series leading to the following observations. In the year 1684, when the second letting took place, the influence of the influx of the precious metals into the country was in full operation; and it is probable that if no other addition to the circulating media had intervened, very little advance in the value of land would have been experienced. But at the close of the seventeenth century a new element was introduced into the circulating medium of the country by the establishment of the Bank of England, and the issue of bank notes. For the first fifty years this had but little influence upon prices, because the Bank was not allowed to issue notes for a less nominal value than £20 until the year 1759, when the privilege was extended to the issue of £10 and £15 notes. The restriction to £20 confined the circulation chiefly to the higher class of merchants and tradesmen; but the issue of £10 and £15 notes brought them within the means of the more humble class of traders and agriculturists. The consequence was that land advanced rapidly, so that we find it increased in value, in the case of Wynfield Manor, from £250 to £1,500 per annum, or 600 per cent. Probably the same land would now let for 25*s.* or 30*s.* per acre, or from 66 to 100 per cent. higher than in 1791.

Other circumstances, however, have now intervened to increase the value of land. The establishment of the cotton manufacture, and consequent creation of extensive markets in the northern hives of industry for every kind of agricultural produce; the great increase of the population; the establishment of banks of issue in all parts of the United Kingdom; the vast extension of foreign commerce, by which the wealth of the country has trebled within fifty years; the institution of the railway system; the employment of machinery and steam in agricultural operations; and lastly, but not least, the important discoveries of the gold fields of California and Australia;—all these circumstances have combined to increase the value of land, and will probably continue to operate as the consumption of the country increases, and the individual accumulation of wealth by commerce and manufactures continues. But we must give a few more illustrations of the progressive increase in the value of real property, to complete the series.

Anno 1082. Robert de Oily holds Burmester for two manors. Those are fifteen and a half hides of land of twenty-two carucates, of which land three hides are in demesne, wherein are six carucates and five servants, and twenty-eight villanes, with fourteen borderers, and they have sixteen carucates. There are two mills of 40*s.* rent, and twelve acres of meadow. A wood of one *quarantine* (forty perches or a furlong) in length, and one in breadth. In the time of Edward (king) it was worth £15, now it is worth £16. (See Kennett's "Barchester.")

"King John, 1203. Brunhall, a manor of King Edward. The land was always twenty-five carucates. In demesne there are three (carucates), there are twenty villanes and eighty-three borderers; they have sixteen carucates, and there may be five more. There is one mill of 10*s.* rent; a meadow of twenty carucates; wood for 200 hogs. In the whole, it pays yearly thirty-eight pounds of *white silver* (*i.e.*, the pure metal before it is coined), and for the forest twelve pounds *burnt and weighed* (*i.e.*, melted down). In the time of King Edward it paid eighteen pounds *in number* (*i.e.*, in ready money)."

1335. Robert, Prior of Bercestre, and his convent, let and demised to John le Mann and Amicia Pekkard, his wife, and Walter Pekkard, their son, one messuage and fifty acres of land belonging to the said priory, to hold for their lives, and the longest liver of them, paying the yearly rent of 24*s.* quarterly.

In Grote's "Antiquities of Warwickshire" we find the following account:—

"9th Edward II. (1316) 160 acres valued at 3*d.* per acre; twenty-four acres of meadow at 3*s.* per acre; certain pasture ground at 20*s.* per annum; a water mill at 26*s.* 8*d.* per annum; pleas and perquisites of court 20*s.*; one croft at 5*s.* per annum; and twenty-four freeholders paying £4 12*s.* 7*d.* yearly (quit) rent. The whole valued at £14 6*s.* 8*d.* per year."

RENTAL OF LANDS, &c., IN COVENTRY AT FOUR DIFFERENT PERIODS.

	(1556) Edw. VI.	1613.	1648.	1684.
	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
Two Houses in High Street	2 0 0	2 14 4	2 16 8	2 10 0
Cotterell's Close	1 0 0	2 13 4	6 13 4	7 0 0
One close and a meadow in Conduit Field	0 16 8	3 0 0	8 0 0	8 0 0
One toft and a piece of pasture	0 14 0	0 14 0	1 0 0	
Hyke's Field	2 8 6	8 11 0	25 0 0	26 0 0
One cottage and garden in Bulkington	0 9 8	0 13 4	10 0 0 (both)	4 0 0
One toft and close of pasture there	0 14 0	1 0 0		8 10 0
Lands in Arley	1 6 8	6 13 4 (both)	6 13 4 (both)	10 0 0 (both)
One messuage and tenement in Slowly Hills	1 3 0			
One-third manor of Old Fillingley	8 0 0	24 0 0	66 13 4	77 0 0
A farm in Betteswell, Leicestershire	1 4 5	3 6 8 (both)	17 0 0 (both)	20 0 0 (both)
Another farm there	1 2 10			
	20 19 9	53 6 0 Increased 2½ times.	143 16 8 Increased 7 times.	164 0 0 Increased near 8 times.

In the last statement we see the progressive effect of the discovery of Mexico, with its stores of gold and silver. At the first date it had not begun to operate in England; but from that time (1556) a continuous advance in the price of land took place, so that in one hundred and twenty-eight years the property referred to had risen in value seven times. This was previous to the establishment of the Bank of England; it is probable that the present value of the property is eight times greater than in 1684, but this we have no means of ascertaining.

Although we have named amongst the causes of the advance in the value of land the discoveries of the gold mines, or fields, in California and Australia, it is proper to state that the effect of these upon prices in this country has been rather collateral and incidental than immediate and direct. By this we mean, that the addition to the circulating medium in consequence of them, though large, would have had no considerable effect on prices, because the country possessed a resource in its paper currency that supplied any amount of capital of equal nominal value, and far more convenient. The amount of gold coined in nine years, from 1848 to 1856, inclusive, was £50,378,000 sterling, part of which was old gold melted down. The amount was certainly needed for the convenience of trade; but all larger transactions were, and always will be, conducted by means of paper money, whilst the credit of the Bank of England remains intact. The new gold coin, therefore, only replaced so much paper money employed in the retail trade of the country. The total imports of gold into the United Kingdom in nine years, from 1851 to 1859, inclusive, amounted to £175,800,810, so that the quantity coined was not one-third, the remainder being exported, as any other article of commerce might be, to the Continent of Europe and other parts of the world.

The way, therefore, in which the influx of gold has affected prices is thus: all the gold that comes here must of necessity be paid for in either money or goods; the bulk of it has been paid for in the latter, and thus an extraordinary demand for British manufactures has been created, which would not otherwise have existed. This extra demand required a large additional number of hands to complete the supply, besides furnishing a greater amount of employment for those already engaged. This, again, created a larger consumption of agricultural produce, which immediately caused an advance in the price of both animal and vegetable provisions, and this, in turn, acted upon the price of land, because it rendered the profits upon its cultivation greater and more certain.

The increase of population, and with it that of individual wealth also, acts powerfully upon the value of landed property by creating a greater competition for its acquisition. The first desire of a man, when he finds that he possesses a surplus of money beyond what his ordinary pursuits of business require, is to become a landed proprietor. Now there is but a certain extent of cultivable land in England, which cannot be increased. It is evident, therefore, that with the additional competition which the increase of individual wealth creates, the value of any article for the acquisition of which a general desire prevails, and the quantity of which in a country cannot be increased, must become greater. And this is precisely the case with the real property of this country; for we find, on the one hand, that when a landed estate is to be sold, the competition is so great that the value has risen from eighteen or twenty years' to twenty-eight and thirty years' purchase, even at the advanced rents which are now obtained for land; on the other hand, no sooner is it known that a farm is, or is likely to become, vacant by the retirement, death, or ejectment of a tenant, than the most active competition commences, and every such change is attended with a further advance in the offers for its possession.

A practical farmer, writing in the *Edinburgh Journal of Agriculture* (January, 1859), on "The Present Position of Agriculture," says, "The greatest enigma at present in agriculture is rent. The most experienced farmer, the most avaricious landlord, the most sanguine improver, is deceived in his calculations in this important element in land transactions. Some accuse the landlords of being too exacting and greedy, and others lay the blame on land-valuators for misleading their employers in the value of land; but the truth is, that both parties are at as great a loss to account for the rise of rents as the most ignorant: for when the former advertises a farm he is sure to get the offer of a higher rent from men likely to prove good tenants than he ever expected, while land-valuators, to keep pace with the offerers for farms, are obliged to put such a value on the subject as may correspond with what it will bring when exposed to public competition, and which is considered its market value, though they do this often against their own judgment. The fact is, the fault lies with the tenants themselves, or rather with the offerers. No sooner is a farm advertised to be let, than there is a keen competition for it from men who have farmed as tenants all their lives, and from those who have never known the anxieties of the farmer's life. High rents are always offered by the latter, and not unfrequently by the former. What, then, can the landlord do but select from the list sent in to him a good practical man offering a good rent?"

This competition for the occupation of land existed to quite as great an extent at the beginning of the present century. The writer, then just setting out in life, was informed that a farm in one of the eastern counties would probably be vacant in a few months, the tenant having engaged, or being about to engage, a larger farm under T. W. Coke, Esq. The agent for the farm in question was Mr. Kent, the well-known steward to his majesty George III. Furnished with a strong recommendation and a whole list of references, he waited upon the great man, and was courteously received, but he was told, "that he might just as well ask for the place of prime minister, for there were at least a hundred applications before him."

Such was then, and has ever since been at intervals, the competition for land; and it does not require much consideration to discover the cause. With regard to the future, there is no probability that it will cease whilst agricultural produce continues at the high price we have seen it of late. This applies specially to the animal products of every kind, the demand for which, while it annually increases, cannot be met by importations to an extent large enough to reduce the price. With respect also to corn, there appears to be a limit to importation, beyond which the cereal countries cannot go without leaving themselves bare, and thus raising the price at home. With the utmost exertion on the part of the importers of wheat, we have never until this year (1860-1) been able to procure more than six and a quarter million quarters. This was in the year 1853, when the deficiency was estimated at ten million quarters. The above importation completely cleared out all the foreign granaries, and it is very probable this will be the case at the present time without producing much effect upon prices here.

With regard to the price of corn, it may be said that the low rates at which it was selling in 1858 and 1859 is an argument against the effect ascribed to the influx of gold. But this is not the case. The low prices were the consequence of abundant harvests, which, with the importations, enabled the producers to meet the demand and retain a surplus in hand besides. Now demand and supply will always regulate prices, independent of the amount of circulating medium. During the two years in question there was always a surplus of corn on the market beyond the immediate demand. The consequence was low prices; for, although the influx of gold created an extra consumption by the activity it threw into the commercial and manufacturing departments of industry, that consumption, so far as bread corn was concerned, was met by an over production, and low prices were the result. The reverse was the case with every kind of animal produce, the supply of which has always been less than the demand; therefore the price has continued to advance.

The above reasoning, if it possesses any force of truth, applies to all times and all seasons, being based upon the immutable principle that demand and supply are the regulators of prices in all commercial transactions, and to which all the other elements and incidents are subordinate. We cannot have a more powerful illustration of this than that in the earlier periods of English history, notwithstanding the scarcity of money was so great that land was to be hired at 3*d.* per acre, the price of wheat sometimes rose far beyond what it has ever done the last three hundred years. We read in an old author, that in the thirteenth century (the year 1270) it sold at £19 16*s.* 9*d.* per quarter, and that two years after, it was £14 17*s.* 6*d.* per quarter. And it is a remarkable fact that the increase of money has put an end to such calamities, the fluctuations in the price of the necessaries of life being infinitely less than in those early times.

The influence of machinery and steam as employed in husbandry upon the price of land cannot admit of a doubt. Whatever lessens the expenses of production, must in the same proportion increase the value of the producing medium. Now, the substitution of mechanical for animal power, however far from perfection the present attempts may be, has already virtually reduced the expense of production by increasing the amount of produce. It is not that the wages of labour are lower, or that fewer labourers are employed on the farm by the substitution of machinery, but that the land is better cultivated, and the average yield larger and better economised. With respect to steam culture we shall have occasion to speak of it hereafter, when we come to describe the several systems now in use. We may, however, observe that the principle is yet in its infancy, it being acknowledged that the plans hitherto adopted are far from realising the ultimate mission of steam power in the operations of husbandry.

SECTION IV.

THE AGGREGATION AND SUBDIVISION OF LAND.

Previous to 1790, a large portion of the lands of England was in the hands of small proprietors, who constituted that famous body of men—the British yeomanry: a middle class of independent freeholders, placed between the rural peasantry and the aristocracy, always favourable to liberty, and ready at any time to fight or die for its maintenance; but at the same time equally devoted to the constitution, and loyal to the sovereign who respected it. They therefore possessed considerable influence, both social and political, in the country, which caused them to be much courted by the upper classes, especially upon the eve of an election. Their knowledge, however, of the principles of agriculture, as they have been since developed, was limited to a routine practised by their fathers before them; and any information conveyed to them by books was treated with sovereign contempt. Experimental farming, out of the ordinary course, was considered a strong symptom of folly, bordering upon insanity; and having satisfied themselves that their system was the best that could possibly be devised, they rested contented with a produce which, at the present day, would be accounted almost a failure.

Whilst peace was maintained in Europe, and the taxation of the country was kept within moderate bounds, these petty "statesmen," as they were called in their localities, managed to support themselves with ease. But when, in 1792, the war with France broke out, it effected a complete change in the condition of the rural districts. The enormous expenditure which then commenced, and which rendered necessary an adequate augmentation of the revenue, increased the taxation, both local and governmental (which fell chiefly upon the land), to such an extent, that it broke down the small proprietors, and it became a question with them whether it would not be more to their advantage to sell their land and become tenant-farmers. Let us suppose, for instance, that a man possessed fifty acres of land unencumbered (a rare case), with a capital of £500 to work it. Land of good quality would sell at that period at £50 per acre; so that we may fairly assume that he had £3,000 laid fast upon his fifty acres. It is true he had no rent to pay; but if he had a family of a wife and five or six children, which every young farmer ought to take into his calculation, he would find it exceedingly difficult to support them, and, besides, pay the numerous taxes, poor-rates, tithes, county rates, &c. &c., with largely advanced prices of labour, consequent upon the dearness of provisions; all of which, in fact, were increased in a far greater proportion than the increased value of his small produce would cover. Under these circumstances, would it not be more advantageous to sell his land, and hire a farm of 300 or 400 acres, for the proper working of which his capital of £3,000 would, with economy, be quite sufficient? Such was the correct reasoning by which the yeomen freeholders of England were transformed into tenant-farmers, occupying larger or smaller tracts of land, according to the capital they were able to command, whether simply by the sale of their estates, or by adding to what they produced by borrowing. In the same way, the "common lands," which belonged to the general body of proprietors in a parish, became first inclosed and parcelled out under acts of parliament, and then, generally speaking, were absorbed by purchase into the estates of the neighbouring gentry.*

The rise of British agriculture may be dated from this period. The large accession of capital thrown into it by the sale of the estates, which, with additions, were frequently let to the former proprietors, enabled the farmers to bestow more expense upon the land; whilst the high price of all kinds of produce during the war stimulated production, and still farther increased the capital employed on it; and a new race of farmers arose, bringing not only capital, but science and intelligence, to bear upon husbandry, which from that period has not ceased to progress. Every year has added, not only

* *Journal of Agriculture*, March, 1859.

to the knowledge of the principles on which the cultivation and growth of plants are based, but also to the value of land, the productive powers of which have been largely increased.

The progress of agriculture and the increase in the value of land in Scotland has been still more remarkable than that of England. Proverbially poor, the people had a sterile soil to contend with, and the drawback of an inhospitable climate to overcome. Land was of little value and the cultivation of the best parts was attended with the most meagre results. The union with England, which had been effected at the commencement of the eighteenth century, was not sanctioned by the masses of the people, and during the first fifty years afterwards, the country was constantly in an incipient state of rebellion, extremely unfavourable to industry of any kind, and especially to the cultivation of the land. The outbreak of 1745 was the last effort of the Stuart party to recover the ascendancy; and its suppression, accompanied with the death or flight of the leaders, showed and convinced the people that it was worse than useless to waste their time, energy, and resources in so hopeless and visionary a cause.

It appears to be the natural course of things, that at least two generations must pass away before any great political change in a country which is not acceptable to the people at large, because it is supposed to affect their nationality, can be so far acquiesced in as to allow them to settle down to habits of industry. Sixty years has not wholly calmed down the resentment of the Irish for the insult (as they deemed it) inflicted upon them by the English government, in abolishing the local legislature; and a considerable section of the people are still endeavouring to raise the cry of "repeal," although the measures of the government have for many years been uniformly calculated to promote their welfare.

Not so the Scotch. No sooner did they find that the Union was *un fait accompli*, which could not possibly be revoked, than they devoted themselves to the consideration of the best means of turning it to account; and well have they succeeded.

"Scotland," says a modern writer,* "exhibits one of the most striking examples of the power of man over nature. I know of only one country that can be compared with it in this respect, and that is Holland. Even Switzerland does not present such great obstacles to human industry; but what adds still more to this marvellous rise of prosperity upon so ungrateful a soil is, that it is all recent. The antecedents of Scotland are different from those of England. Only a century ago, it was one of the poorest and most barbarous countries in Europe; but now, although the last remains of its ancient poverty have not quite disappeared, it may be said that, upon the whole, there is not a better regulated country under the sun.

"The total production during the last hundred years has increased tenfold. Agricultural products alone have increased at an enormous ratio; Scotch agriculture is at this day superior to English, in some districts at least. It is to the model farms of Scotland people send their sons to be taught farming. The best books upon farming which have appeared of late years, have been published in Scotland; and when an English proprietor requires a good bailiff, he generally sends to Scotland for one."

Many circumstances have united to occasion this rapid transition from the most proverbial poverty to general wealth. The basis of it is found, undoubtedly, in that

* De Lavergne, "Rural Economy of England, Scotland, and Ireland." Published by Blackwood & Son, Edinburgh.

steadiness of character and habits of reflective economy by which the people generally are distinguished; and it may be said, that to this must be ascribed the singular tact with which they established that admirable system of banking which, while by liberal advances of money it rendered assistance to any one who was rich enough in friends to find two responsible securities, was managed with so much prudence and foresight, that while the bank failures in England had amounted to between four and five hundred, not more than seven or eight had occurred in the same period in Scotland. The system of leases in Scotland, we have already referred to. With this, the large and middle-sized farms prevail, there being very few of less extent than fifty acres, and not many so small, and they are found chiefly in the Lowlands.

The tenure by which the landed proprietors of Scotland hold their possessions is, in almost all cases, by fee-in-tail; and even the leases of farms, if the lessee dies, go to his heir, to the exclusion of the younger children. This is certainly a hardship upon the latter; but there cannot be a doubt that it has prevented that subdivision which has been the bane of Ireland, and is now occasioning so much perplexity in France. The landed estates in Scotland are very large, especially in the Highlands, where they contain, in some instances, 200,000, 400,000, and even 700,000 acres.* The average, however, is about 2,500 acres; whilst in the Lowlands they do not exceed 500 acres.

Until the middle of the last century the estates in Scotland were held under the patriarchal system, strengthened by the strictest feudalism. The people in the Highlands were divided into clans, which were, in fact, families—all the members of the clan being connected by the ties of relationship. The land was vested in the chief, who held his office of headship of the clan, both by descent and prescription, for the benefit of the clan. The cultivation of the soil was confined to the valleys, and the produce was chiefly oats; but the people lived more by the fruits of the chase, and by raids upon each other, and especially upon the Lowlanders (such petty warfare being a normal institution of the country), than by honest industry. Trained to this barbarous habit, they despised the arts of peace, and the land was mostly cultivated by the women. The chiefs resided in strongholds, large enough to contain a considerable body of their followers, and strong enough to resist the imperfect munitions of war their equally barbarous neighbours could bring to assail them. The battle of Culloden put the finishing stroke to this system; and, by leading the chiefs to reside part of their time in England, speedily produced an entire change in the social as well as the political condition of the nation.

The breaking up of the system of clanship in Scotland, and the appropriation of the land as private property, has led to extensive emigration amongst the Highlanders, who in the United States and Canada, especially the latter, constitute the most intelligent and prosperous portions of the community. On the other hand, land has increased in value to an enormous extent in some parts, near the large cities and towns;† and

* De Lavergne.

† A striking instance of this is recorded in Anderson's work on Scotland. A gentleman who had acquired a large fortune in India, purchased upwards of 25,000 acres of land in the neighbourhood of Aberdeen. It was covered with boulders of granite rock, whilst the scanty grass between, afforded meagre pasturage for a few sheep. This land previously let at 2*s.* per acre. The new proprietor blasted and removed the boulders, drained the land, which he levelled and limed, and altogether expended £20 per acre upon it,—the original cost being £5 per acre, or £120,000. This land, thus improved, brought the proprietor readily a rental of from £5 to £8 per acre, whilst the neighbourhood itself is changed from a barren desert into a smiling and fruitful ornament to the environs of Aberdeen.

the skill, industry, and economic habits of the people, being brought to bear upon agriculture, has changed, not only the face of the country, but even the climate, the winters commencing a month later, and the snow disappearing a month sooner than formerly.

It is, however, in the Lowlands that the value of land has so much increased. The Lothians, which surround Edinburgh, and which were formerly considered incapable of bearing any more valuable crops than barley and oats, and brought the proprietor only a few shillings per acre, now let for from 30*s.* to £5 per acre,* and some of the finest wheat in the United Kingdom—and as such sold for seed-wheat in both England and Ireland—is produced there.

Such are the results in the two countries, England and Scotland, where the land has been divided into comparatively large holdings, requiring capitals to stock and work them. The advocates of the opposite system assert that this prosperity is not attributable to the size of the farms, but to a variety of circumstances which do not exist in those countries where the land is subdivided to infinity. They assert that in the latter a want of capital will account for the low state of agriculture; and the same plea is made use of in Ireland by those who are disposed to support the system, whilst they look despairingly upon its results. The following observations by a distinguished writer in that country are to the point. "There is another circumstance, so popularly counted on as a most material obstacle to the development of industry in Ireland, that I cannot leave the subject without briefly adverting to it—that is, the want of capital. This has been the bugbear of Irish enterprise for many years. England has capital, Ireland has none; therefore England is rich and industrious, and Ireland is poor and idle. But where was the capital when England began to grow rich? It was the industry that made the capital, not the capital the industry. An idle or ignorant man will lose his capital where an active and intelligent man will create a capital. We leave our fields in barrenness, our mines unsought, our powers of motion unapplied, waiting for English capital. Labour is capital, intelligence is capital. Combine them, and you more than double your capital. With such capital England commenced, as Ireland must commence; and once we have begun, and are in earnest, there will be no lack of capital at our disposal."†

The case of Scotland is a sufficient answer to the complaint of the Irish of a want of capital. No people could be, either individually, or collectively, less wealthy than they; and the unexampled prosperity in which we now find them is the result of persevering industry, united with rigid economy, inflexible integrity, and the absence of that absurd pride which leads the Irish to look upon labour as a disgrace, and to aim at being independent gentlemen without having the means to sustain the character. This has led the smaller gentry to educate their younger sons for the law, or the church, or the medical profession, rather than for trade or agriculture; and the consequence is, that all these professions, especially the first and last, have been overdone in Ireland. We believe, however, that, owing to the efforts and teachings of the eminent writer of the paragraph we have just quoted, and other patriotic and influential men, and above all, by the untiring exertions of the Royal Dublin Society and other kindred institutions, this spirit is fast disappearing, and that industrial pursuits, with agriculture in the foreground, are making rapid progress. Nothing could more forcibly illustrate the different effects

* The Scotch acre is about $1\frac{1}{4}$ imperial acre.

† "Industrial Resources of Ireland," by Robert Kane, p. 388.

of large and small farming than the change which has taken place in Ireland since the famine, and the passing of the Encumbered Estates Act. Previous to the year 1846 the number and extent of farms in Ireland were as follows:—

From 1 to 5 acres	309,915
„ 5 „ 15 „	251,128
„ 15 „ 30 „	78,954
Above 30 „	48,312

But even these figures do not represent the entire subdivision of the soil; many of the smaller holdings being still further reduced upon the marriage of the son or daughter of the lessee or occupier; in which case a portion of the land is given to the husband for the support of himself and wife, the father still standing on the books of the proprietor as the tenant for the whole. This system was carried to a great length in Ireland without a legal enactment like that in force in France and other continental countries, but it utterly broke down when tested by the failure of the potato crop, which had previously been almost the entire support of the peasantry in the rural districts. So entire was the desolation produced by that calamity that in 1849-50 you might travel twenty miles in many parts of the country, and not meet with a single man, woman, or child, or a single animal of any kind whatever, the human beings having been carried off by famine, fever, or cholera, which succeeded each other, or having abandoned a country which no longer afforded them support; and the cattle, sheep, horses, and pigs, having been either devoured by the starving population, or sold to purchase other food, or afford the means of emigration.

Since that awful period a material change has taken place. Many of the large estates having been almost forsaken by the tenantry, have since been divided, by a fresh arrangement, into large holdings. Thus, on the estate of the Marquis of Lansdowne, in Kerry, consisting of 100,000 acres, the population amounted before the famine to 16,000 souls. Of these, one-fourth died from hunger or disease; another fourth emigrated; "and it was calculated that the continuance of the exodus would reduce the population of the estate to one-eighth of its original proportion—say 2,000, which is quite sufficient to bring the land into value."* So early as 1851 the number of holdings had been decreased in Ireland to the following proportions:—

From 1 to 5 acres	88,083	Decrease	222,292	
„ 5 „ 15 „	191,854	„	60,924	
				283,216
„ 15 „ 30 „	141,311	Increase	61,973	
Above 30 „	149,090	„	100,467	
				162,440

This process has been going on ever since, partly by emigration, but chiefly by means of the Encumbered Estates Court, so that in 1856 the numbers stood as follows:—

From 1 to 5 acres	82,035	Decrease	6,048	
„ 5 „ 15 „	179,931	„	11,923	
				17,971

The larger farms have, of course, increased in proportion, and this increase of the latter and decrease of the former is still proceeding, the peasant farmers having learned by

* De Lavergne, "Rural Economy," &c., p. 391.

the reports of their friends in America that they can become proprietors there instead of tenants in Ireland.

"What a contrast is Ireland of 1847 and 1851 with Ireland in 1858! No country has ever made such rapid progress in so short a period. There is little or no pauperism, labourers are fully employed, though wages are still too low; the farms are fully stocked, and rents are well paid; and many of the farmers have accumulated money. The laws are obeyed and respected, and there is an almost absence of crime; and peace, contentment, and happiness prevail throughout the length and breadth of the land." *

This extraordinary change has been effected undoubtedly in the main by what must still be considered as a heavy and calamitous visitation of Providence; and as a result of that calamity, the establishment of the Encumbered Estates Court, the change of proprietary, with new indisputable freehold titles, and a large infusion of Scotch and English farmers, whose example and influence are silently working that revolution in which the efforts of previous institutions made but slow progress. Between 1848 and 1858 there have settled in Ireland, six hundred and sixty Scotch, and ninety-six English farmers—all of them possessing capital and skill, many of them having purchased the farms they occupy. One of these, Mr. Allan Pollok, has been one of the largest purchasers in the Encumbered Estates Court. The property he has thus secured, is, we believe, chiefly in the county of Galway, and the improvements he has made, with the aid of a princely fortune, have rendered him the admiration of the whole country. "Plans, skilfully matured, have been carried out with great vigour; no obstacles were suffered to interrupt them; ample funds were at command for every purpose; thousands of labourers were employed at good wages, punctually paid; and an example shown of what can be effected on Irish soil by an outlay of capital, directed by skill, prudence, and energy. Mr. Pollok is now letting his improved farms to English and Scotch farmers." †

The great argument of the advocates for small farming is, that the aggregate of produce is greater, and that, consequently, more persons can be supported upon a given quantity of land. We will grant this for the sake of argument, but at the same time observe that it is this very circumstance which originates the worst feature of the system—the constant tendency to produce a redundant rural population, which is the case in every country in which small farming is the rule. That it was so in Ireland previous to the famine is proved beyond a question, both by the misery in which the peasantry lived, the extremely low rate of wages,‡ and the enormous extent of pauperism. Their chief, and almost only food, was potatoes and buttermilk, with a change of oatmeal porridge whilst the oats lasted. The rent of the land was generally made up by wages in England during the hay and wheat harvest, the families living the while upon the remains of the previous year's crop. If that lasted, they were fortunate; if not, they begged of their neighbours. They now live in comfort, having abundance of employment at good wages, and the support of the paupers amounted in 1857 to only £490,000, the rates ranging from 4*d.* to 1*s.* 6*d.* in the pound for the whole year.

* "The Agricultural and Social State of Ireland in 1858," by Thomas Miller, p. 30.

† Ibid., p. 12.

‡ During his residence in Ireland the writer has known able-bodied labourers hired by the hundred together at $3\frac{1}{2}$*d.* and 4*d.* a day. "Does your honour want a man?" said a stout fellow to a farmer at Ballinasloe fair. "Well, Pat, what do you ask for your work?" "Sure an' your honour won't think 4*d.* a day too much?" This passed in the hearing of a friend of the writer's.

Nearly half the outlay for the support of the poor-houses was swallowed up by the salaries of officials, and other expenses than the actual support of the paupers. In 1856, those salaries, &c., amounted to £215,202. The improved condition of the general body of the rural population, and the superiority of their position to that they occupied as peasant farmers, cannot be disputed for a moment by those who knew the country under the old system.

The tendency we have referred to, of the subdivision of the land to increase the rural population beyond the means of the soil to support it, is now manifesting itself in a remarkable and rather alarming manner in some of the best departments of France in respect to local advantages. That of the Nord, for instance, possesses a rich soil, cultivated upon the Flemish system, and productive beyond any other part of France, it enjoys all the advantages of access to the best markets by means of excellent highways, canals, and railroads; and yet, of this favoured district M. de Lavergne writes as follows:—"Unfortunately, this profitable cultivation has one capital vice, which restores the balance in favour of English farming—the excess of the rural population. In spite of the developments of manufactures and commerce, those who subsist by agriculture constitute nearly one half of the population, which gives a proportion of 100 to every 100 hectares (or one to every two and a half acres), or more than any country in the world, except China. Such a superabundance of hands is not necessarily the consequence of small farming, but it is its natural tendency. If Flanders produces more than England in proportion to its surface, it produces only half relatively with its rural population. *There is in no part of the world* so many poor as in this rich and productive country. The city of Lille forms a melancholy exception to all that is known in this respect; the third of its inhabitants are supported by the charitable board, and more than one rural commune has an equal proportion of poor. In face of such a scourge, these admirable fields lose much of their merit."*

Again, in the valley of the Rhine, which is justly considered the best cultivated part of France, the subdivision of the soil has been carried to such a pitch by the operation of the law of succession, that the department of the Lower Rhine, containing 1,124,135 acres, is divided into more than two million parcels or slips of land, and the number is increasing with fearful rapidity. M. Lavergne, in speaking of this region of France, states the opinion of M. Oppermann, and remarks upon it:—"The opinion of M. Oppermann is strongly expressed, but it evidently contains a portion of truth. The extent cultivated has been increased by clearings, but the average return has not changed; it was formerly as now, nineteen to twenty hectolitres per hectare (seventeen to eighteen bushels per acre) of wheat. The average revenue is rather lower than otherwise. We must retrace our steps, which is not easy." . . . "Another writer who has come forward about the same time, M. Pariset, member of the Agricultural Committee of Lunéville, gives still more melancholy details respecting that part of Lorraine which joins Alsace. 'The subdivision in this department,' says he, 'has been carried to that extreme length, that many slips do not contain more than four, three, or two *ares* (or, respectively, 476, 357, and 238 square yards), and even less still. The ancient triennial system of farming, carried to the utmost, has impoverished the soil. The extent of meadows and pastures has decreased, whilst the arable portion has increased without any corresponding extension of forage crops. Sheep have disappeared, and large cattle do not increase,

* Lavergne, "Economie Rurale de France," p. 82.

whilst the average return of wheat is lowered.' The subdivision of the land into slips is the principal cause of these complaints. 'The present system,' says M. Pariset, 'is at an end; it is leading us to a condition which calamitous years have revealed, but not created. Our farmers are getting into debt, and are debilitated in body and mind. Any modification whatever of the crops will be impossible whilst the parcels of land remain entangled as they are. How can artificial pastures be made in the midst of these slips, destitute of roads? Can anything else than wheat or oats be sown in the soil appropriated to these cereals? Can we cross over land under crops? The state of the soil points out the only course we are permitted to move in.'"*

PLAN OF SUBDIVISION AND REUNION.—The only remedy yet discovered for this evil—for such its most strenuous advocates consider it—is to throw the whole of a district into one parcel, and then, divide it again, so that each proprietor should have his land, whether much or little, in one block. To make the system clear respecting the mode in which the soil is thus cut into slips, let us suppose that a man dies, leaving four children, and possessed of four acres of land, *i. e.* one acre of arable, one of meadow, one of vineyard, and one of wood. According to the law of France, each of his children can claim a fourth part of each of those acres, by which the man's estate will be divided into sixteen portions, instead of being preserved in one block, as it would be if the eldest son inherited it. This is, in fact, the common case with these small properties. So great is the passion for the possession of land, that very few of the children of proprietors are found who are willing to sell their portions. The remedy we have referred to has been put in practice in Prussia, Bavaria, Hanover, Saxony, &c. &c., but not to any extent yet in France. In Prussia, 50,000,000 journals,† the property of 1,600,000 proprietors, have been thus treated; but it is evident that, while the system continues, the same process will have to be repeated in a few years, as the parcelling, subdivision, and consequent entanglement of the land will also take place.

The eagerness of the French peasant farmers to possess land naturally raises its value; and we find the writers on agriculture in that country exclaiming loudly against this fatal infatuation, which involves the purchasers in heavy debts, that the produce will not enable them to discharge. The common interest paid by the rural proprietors, for money advanced to them upon the purchases of land is 6 per cent., whilst the value of land is as high as it is in England, where money can be obtained on mortgage at 3 or 3½ per. cent. On the other hand, the produce in the latter is much greater than in the former, and rents are higher; so that the purchaser of land in England, whether he occupies it himself, or lets it to a farmer, has the double advantage of a better income to receive and less interest to pay. This part of the subject will be more fully treated when we come to speak of French agriculture.

* Lavergne, p. 168.

† A journal of land is as much as a plough can till in one day, which is about an acre. The term is Saxon.

SECTION V.

COTTAGE ALLOTMENTS.

Amongst the various schemes advocated and partially adopted for improving the condition of the labourer, and enabling him to obtain many of the comforts of life, from which, in consequence of the low price of agricultural labour, he is otherwise debarred, is that of allotting to every married farm labourer a portion of land, at a certain rental, and larger or smaller, according to the number of his family. As this system has been the subject of controversy, and has many opponents among the agriculturists, we shall review the arguments for and against it.

The avowed objects proposed by the advocates of cottage allotments are "to increase the resources of the labourer by supplying him with many necessaries and comforts, which he would have difficulty in purchasing from a portion of his wages, and which, even if he could do so, he would purchase at a great disadvantage; and also by enabling him to turn everything to profit, so that nothing need be lost." There are, besides these main objects in favour of the plan, many collateral ones, which in process of time might work a revolution of the most beneficial kind in the character and habits of the agricultural labourer. In his present position, with wages inadequate to the wants of a family, or for providing those domestic comforts which render a cottage a desirable home, he is too frequently driven or enticed to the public-house or the beer-shop,—those curses of the rural districts,—still further to abridge the comforts of the family by expending a greater or less portion of his wages in drink. The labourer, in fact, with a family, has nothing to look forward to but the Union Workhouse, if his life is spared beyond his capacity for labour; and a feeling of this total inability to better his condition and make provision against old age or sickness, too often renders him reckless of consequences and indifferent to the wants of his family.

It appears, therefore, that the acquisition of a portion of land sufficient to occupy his spare time, and that of his family, without entrenching upon his regular occupation as a farm labourer, is the very thing that is wanted to effect a moral change in his character, whilst it is calculated to improve his social and material condition of life. With such a stimulus, he would feel that the hours he spent in the dissipation of the beer-shop are so much loss of profit to be obtained from his allotment; and that every hour he spent in its cultivation was so much additional enjoyment to himself and his family.

Assuming that the plan is worthy of adoption, there are other questions connected with it, upon which its success may be said to hinge. The first is the quantity of land of which the allotment should consist, and this should be limited to the ability of the allottee to cultivate it without interfering with his regular hours of labour for his employer. To allow him to have more than this, would be a positive injury to him, by unsettling him at his regular employment, without materially assisting him in the cultivation of his land. It has been deemed that one half to one fourth of an acre is as much as one man can well manage to cultivate to advantage; but if he has a family growing up who can assist him, a larger portion would perhaps be desirable. It is a question, however, whether the interests of the family would not be much better promoted by disposing of the children in domestic service as they arrive at the proper age, rather than by keeping them at home to assist in tilling the allotment. This is, beyond a doubt, the case with the female branches of the labourer's family, who, if brought up in a proper manner, are certain of obtaining situations as domestic servants at high wages. And with regard to the male children, it would be far better for their future welfare to be placed under a master, with whom they would acquire regular and industrious habits, than to be employed in the desultory work of the comparatively small portion of land occupied by the family.

A second question is, whether it would be most advantageous to have the allotment in arable land, so as to produce the vegetable food required for the family; or in pasture, so as to enable the labourer to keep a cow, the produce of which might in part be sold, and in part go to the maintenance of the family. Perhaps it would be better to have half in arable and half in pasture, so as to be able to keep the cow in winter as well as in summer. By this plan the wife and daughters would find ample employment, whilst the husband would have less time taken up in cultivating the land. This plan has been tried, and pasture land enough to keep one or two cows has been allotted to farm labourers without any inconvenience arising from it. On the other hand, few labourers have money enough saved out of their scanty earnings to purchase a cow, or even a pig, and they would, therefore, in the first instance, require assistance for that purpose.

"Poverty," says a practical man, "will never enter the dwelling of an industrious labouring man (I proceed on the supposition that he is constantly employed at from 9*s*. to 12*s*. per week) if he once can obtain possession of an acre of ground at a moderate rent, and a cow, provided that it pleases the Almighty to bless him and his family with health. So numerous are the benefits derived from this inestimable creature, that no man ought to rest satisfied till he has accomplished the object of what ought to be his constant and unceasing endeavours. A good cow will supply a large family with milk and butter (and a great deal of the latter to spare) for forty weeks, and cheese all the year round. I made from one cow 217 lbs. of butter in thirty-nine weeks. But suppose an ordinary cow to produce 180 lbs., and allow 80 lbs for the use of the family,—and no poor family ought to use more,—there will be then 100 lbs. to dispose of, say at 8*d*. per lb.;* there is upwards of three guineas, at once, ready to pay the rent, &c. &c., or to buy a couple of pigs; for a man who keeps a cow should never have less

* The price *now* for good fresh butter averages double that price.

than two (pigs) in the sty. A cow produces a great deal of wash for the hog-tubs. There is the washing of the milk bowls twice a day; a lot of whey three or four times a week, for a skimmed-milk cheese should be made twice a week, while the milk is plentiful; if the curd is made while the milk is sweet, it will keep well for three or four days with a little salt sprinkled over it, and covered with a cloth in a cullender. Twice a week there will be the washings of the butter and churn; the little urchins will drink the buttermilk. Indeed the refuse of everything connected with a dairy becomes an excellent ingredient in the hog-tubs."*

To maintain the cow upon one acre of land, the same writer recommends the following arrangement:—

$$1 \text{ Acre} \begin{cases} 80 \text{ rods of grass land.} \\ 40 \quad \text{do.} \quad \text{mangold wurzel.} \\ 40 \quad \text{do.} \quad \text{kitchen-garden.} \end{cases}$$

The following unanswerable reasons for the adoption of cottage allotments are given in the same work:—

"1st. Every cottager requires, for the consumption and use of his family, a certain quantity of culinary vegetables and fuel.

"2nd. Every labourer, mechanic, operative, manufacturer, or small tradesman, has, or ought to have, some hours of leisure every day, for the purpose of health, recreation, and enjoyment.

"3rd. *Recreation is not idleness*, but a change in the kind and degree of labour or occupation.

"4th. The raising or culture of all his vegetables, including potatoes, for his family, and one or two pigs, and poultry, &c., and fuel, may be made the recreation of the cottager and his family, without infringing one hour on the time allotted to his business.

"5th. Being so raised, they will cost the cottager less than what they could be produced for by those who raise them as a matter of business, and not of recreation.

"6th. The sense of property, the possession of a comfortable home, and the social affections and local attachments thereby produced, will greatly increase the enjoyments of the cottager, and in every way render him a better member of society."†

If in expressing an approval of the foregoing arguments for the plan of cottage allotments, it should be said that we are neutralising what we have previously urged against the system of small farming, as practised in Ireland and on the Continent, we reply that in these latter cases the land has been the sole dependence, and furnished the sole employment of the people; whereas the plan of cottage allotments pre-supposes that the allottee is still constantly employed at his regular work, and at regular wages, the allotment being an additional and auxiliary source of emolument for his support and comfort, and affording him an interesting and useful means of employing his leisure time without having recourse to dissipation of the lowest and worst kind, as is now too much the case. It is a well-established fact, too, that those agricultural labourers who have had land enough to provide vegetables and potatoes for their families, or to keep a cow and a pig, have been the last to apply for parish relief. This of itself is a powerful argument in favour of the plan.

* Loudon's "Manual of Cottage Garden Husbandry," &c., p. 45.

† Ibid., p. 4.

We shall now, in fairness, state the objections that are urged to the system of cottage allotments.

"1st. Those who erect cottages in the rural districts have usually built them attached in rows or streets, which renders it impossible for the allotments in such cases to surround the dwellings—a circumstance necessary in order that the cottager should derive full benefit from them. When the land surrounds the cottage the children may be occupied upon it without being removed from the mother's superintendence. The father, who, after a day's work, would hesitate to walk a quarter of a mile and back, may easily apply a little labour to his garden without separating himself from his family.

"2nd. The peasantry are ignorant of the value of allotments, and the mode of cultivating them. These circumstances present difficulties which nothing but an early training in industrial schools, arranged for the purpose, can completely overcome.

"3rd. The farmers generally have strong prejudices against the system."*

The first objection to the plan is not insurmountable, for in some districts the allotments have been all made in one field, lying contiguous to each other; and it has been found, that so far from the allottees neglecting to cultivate their plots on account of their not lying round their cottages, the circumstance of their contiguity has created an emulation as to which shall produce the most, or the best quality, of the various kinds of vegetables; and we find that at the shows of agricultural produce, the cottiers hold no mean place as the growers of the best roots, &c.

The second objection will undoubtedly hold good, as it applies to mechanics and artizans, who know nothing of the cultivation of the land; but even these are not, we presume, above being taught: and as to the farm labourers, surely they know enough by experience by the time they arrive at an age to take a wife, to be able to manage half an acre or an acre of land; and it is these chiefly that are contemplated by the plan.

The third objection, we believe, is giving way, and that the farmers very generally are satisfied that cottage allotments are as much for their benefit as for that of the labourers; that it not only gives them more ability and more spirit for labour, but that it makes them better satisfied with their position in society, when they find that their welfare is the object of consideration with those who are above them in the social scale.

In Switzerland and those regions of France bordering upon the Alps, where cows are kept by all the cottagers, they have an excellent plan for making the best of the produce. The inhabitants of a commune form themselves into an association, and establish a public dairy, called a *fruitière*. An experienced and trustworthy dairyman is engaged to take charge of the establishment; and every night and morning the cottiers send thither the milk produced by their cows, the exact quantity of which is taken account of and entered in a book, a duplicate of which is kept by the owner. If any one is detected in mixing water in the milk, he is excluded from the association, which is tantamount to being ruined. The milk is all made, in its new state, into large cheeses; and at the end of the season these are sold in Paris and other great cities, where, being of the finest make and quality, they generally fetch high prices. The proceeds are then divided amongst the cottage proprietors, according to the quantity of milk each one has sent into the dairy. Should the system of cottage allotments of land, half pasture and half arable, be generally adopted, so as to enable the labourer to keep one or two cows

* "Penny Cyclopædia."

during the summer, perhaps the French plan would be worth a trial for converting the produce, or a part of it, into either butter or cheese, which would be certain of being of the best make and quality, which is not always, or often, the case with small makers.

This plan of cottage allotments, we repeat, is quite different from small farming, and may rather be considered as gardening, it being the object to raise vegetables of all kinds for the use of the labourer's family, whilst the cow, if he keeps one, supplies them with animal food in the shape of milk, butter, cream and cheese. It has also been rendered necessary, as an act of justice to the labourer, by his having been deprived of the commons, upon which, previous to the war with France, he was able to keep a cow through the summer, and in some cases, where the cottager had a garden, through the winter also. This was all taken from him by the General Enclosure Act, which, while it ostensibly awarded to him an equivalent portion of the common land, compelled him, by the expense of enclosing, which he was unable to defray, to sell it to his richer neighbour, by whom the greater portion of the enclosed land was absorbed. He has, therefore, a just claim upon the proprietor of land for a compensating allotment on lease, sufficient, but not more, to supply himself and his family with the vegetables that are necessary to sustain them in health.

It is to the honour of many landowners that they have fully recognised this claim, and have allotted to the labourers upon their estates a portion of land sufficient for their domestic purposes. Amongst these, Captain Scobell, in Shropshire, was perhaps one of the first, and the result was so satisfactory to him, and so much appreciated by his neighbours, that twelve other parishes adopted the plan, and upwards of 500 agricultural labourers and miners had allotments let to them at a rental of $2\frac{1}{2}d.$ to $3\frac{1}{2}d.$ per square rod, the quantity in few cases exceeding forty or fifty rods, the average being thirty-four or thirty-five rods. Captain Scobell's cottier tenants numbered 179 in the two parishes of High Littleton and Midsomer Norton. They all paid their rent regularly, and in three years not one of them had been convicted of any offence against the laws. The land was chiefly tilled by the wives and children, as the men still held their situations as labourers or miners.

The following single case, recorded by Sir W. Pulteney, and referred to by W. C. Johnson in his "Farmer's Encyclopædia," is remarkable for its result:—"On Pulley Common, in Shropshire, there is, or there was, a cottager's tenement of about 512 square yards, somewhat more than one ninth of an acre. The spade and the hoe are the only implements used, and those chiefly by the wife, that the man may follow his daily labour for hire. The plot of ground is divided into two parcels, whereon she grows wheat and potatoes alternately. In the month of October, when the potatoes are ripe, she takes off the stalks, which she secures to produce manure by littering her pig. She then goes over the whole with a rake to collect the weeds for the dunghill. She next sows the wheat, and then takes up the potatoes with a three-pronged fork, and by this operation the wheat seed is covered deep. She leaves it quite rough, and the winter's frost mellows the earth, and by its falling down in the spring it adds vigour to the wheat plants. She has pursued this alternate system of cropping for several years, without any diminution of produce. The potatoe crop only has manure. In 1804, a year very noted for mildew, she had *fifteen Winchester bushels of wheat*, from 272 square yards (one seventeenth of an acre), being four times the general average crop of the neighbouring farmers. It is to be wished such instances of cottage industry were frequent;

and more frequent they would be, were proper means made use of to invigorate the spirit of exertion in the labouring class."

That the bestowment of cottage allotments acts upon the mind of the labouring classes as a powerful stimulant to exertion and a desire to rise above the condition of poverty, which a sole dependence upon the wages he receives as a husbandman, sooner or later, almost inevitably involves, there cannot exist a doubt. Those who apprehend that it will render the labourer more independent, and less willing to obey his employer, or fulfil the duties of his station, take a very ignorant and narrow view of human nature. Any plan, on the contrary, which reforms the habits of the peasantry by enabling them profitably to occupy their leisure without having recourse to dissipation and vice, necessarily makes them better, and not worse servants, even if gratitude be left out of the question. We maintain that the concession of a plot of ground binds the peasant more strongly to his employer; whilst the increasing habit of industrial occupation makes even his regular employment as an agricultural labourer less onerous to him.

It is in those cases where the plot of ground (as in Ireland and in France) becomes the sole support of the husbandman that habits of idleness are displayed. Without sufficient employment to occupy the whole of his time he has no stimulus, when his potatoes are planted, or his oats sown, to find other fields for exertion, because his neighbours around him, being equally poor, can afford him no means of improving his condition. We have ample evidence in both countries that the system of small farming is injurious to a country; whilst the occupier is far worse off in every respect than the agricultural labourer of England. The only thing wanted by the latter is the allotment of land, to make his position comfortable and advantageous both to himself and to his employer, whose direct interest it is to see that those he employs have no reason to complain. This is especially the case at the present time, now that the agricultural labourers have found their way to the United States and Canada, where most of them had friends who duly reported to them the progress they were making. There is thence a general impression with the labouring class, that unless some improvement is made in their condition by an advance in the price of labour, or the expedient of cottage allotments, it will be better for them to follow their former companions to the new world. This feeling has already been extensively acted upon, and has had a material effect upon the supply of labour, which in many parts of the country is very inadequate to the demand at certain times of the year. If, therefore, the farmers are desirous of not further having the supply diminished, they must set about improving the condition of their labourers by giving them the means of increasing their incomes, without a larger advance of wages than the price of produce will allow; and this can only be done by adopting the allotment system, which, while it will place the labourer in a better position, will attach him to the soil, and render him more contented with his condition of life.

SECTION VI.

RURAL ECONOMY.—THE FARM LABOURER, HIS RIGHTS AND DUTIES.

Rural Economy has been described as comprehending, in a general way, the amelioration and improvement of every kind of rural property. It embraces, therefore, the laying out, enclosing, and cultivating of land, and the management of the different practices, operations, and processes which have relation thereto, or to its produce: the regulation of the various kinds of labour which attend them; the disposal of different articles of provisions raised upon the land, at fairs and markets; in short, embracing every subject connected with rural affairs and the pursuits of husbandry. This is the definition given of the term in Rees' Encyclopædia; but a more modern application of it imparts to it a greater distinctness and a more appropriate meaning.

A young man, starting in life, finds himself in possession of just sufficient money to stock and carry on a farm of 200 acres, without the means of increasing his capital by any chance. It would be good economy for him resolutely to determine not to be tempted to exceed that quantity of land, but rather look below it than above it in the selection of a farm. But another opportunity presents itself of obtaining one of 250 or 300 acres, and he embraces it. This is *not* economy, but an abandonment of it; because, at the outset, he finds himself so cramped for capital, that he is unable to effect those improvements which are of so much importance to be done at the commencement of a lease, in order to reap the full benefit of them during the term, and for want of which his fields will never yield their full produce. Many farmers, with just sufficient capital to manage the lands they occupy to advantage, are tempted, by the offer of others contiguous to their own, to increase the size of their farms, by which they find themselves hampered and embarrassed for life, without reaping a larger profit from the additional extent of land.

It may be good policy (so far as profit is concerned) in a new country, to occupy a large rather than a small tract of land. Washington, in reply to Sir John Sinclair, who, in a letter, asked how it was that the rich lands of America produced only eight bushels of wheat per acre, said that "in that country land was so cheap, and labour so dear, that it answered better to cultivate a large quantity badly than a small one well." The farmers of the United States have generally acted upon this principle, and have therefore undoubtedly found it correct, so far as their own individual interests are concerned. But in a national point of view it is destructive of economy, because the lands become exhausted under the system, and thousands of acres have gone out of cultivation in the eastern states, whilst the aggregate produce of those states declines yearly.

But whatever may be the case in that country, it cannot apply to our own, where the rent of land, and the expense of stocking and cultivating it exceeds by five or six-fold that of the United States. It is the greatest error a young man can commit on entering into life, to take more land than he has capital fairly to carry it on. It is, perhaps, one of the principal causes of the success of agriculture in Scotland, that no farmer, if he has only money enough to stock, &c., fifty acres, would on any account exceed that quantity. Rural economy, in fact, is better understood, and more efficiently carried out, by the Scottish farmers, than by the English, and their success has been the more certain.

Rural economy, then, embraces the entire range of agriculture in theory and practice. In the present state of knowledge of the subject, it includes a certain amount of scientific acquaintance with the principles on which the art is founded, and with the nature and habits of the plants and animals which are its results. Without this knowledge, the farmer of the present day will, like his ancestors, be groping in the dark, and either farming his fields at hazard, or in a stereotyped path, with no other reason to allege for it than that his father practised it before him. Perhaps there is no department in the management of a farm in which economy is less understood by the generality of cultivators than in the treatment and remuneration of labourers, who are the working wheels, as the master is the mainspring, of the machine. To a consideration of this branch of the subject we shall now direct the attention of the reader.

That "labour is the basis and origin of all wealth,"—commercial, manufacturing, and agricultural,—is an axiom which no man of reflection will controvert. Of what value were the gold-fields of California to the Spaniards during the three hundred years of their possession of that country? What was it that stamped a value of many millions sterling annually upon them from almost the moment that Spain had abandoned the country (for a small consideration) to the United States government? What, again, was it that in thirty years raised Chicago from a small village, not considered worth inserting in a gazetteer, to a city containing a wealthy and flourishing community of 130,000 inhabitants? These and such as these results are the effects of labour. It is this that stamps a value upon everything that the earth contains or produces, and upon the land itself; for where no labour is, or where there is a deficiency of labour, there land is of little or no value. In England, as we have already shown, whilst the land was in excess of the wants of the population, its value was as nothing compared with what it now is. It is labour that has been the chief cause of its present value; and it is meet that the condition of the class of men who have been instrumental in producing this result should occupy a large space in the consideration of those who reap the benefit of their labour.

"Farm labourers," says Paley, "being the most valuable class of men that a populous country possesses, should have every comfort provided for them that is compatible with their situation, and conformable to the general interests of the community. Their wages ought to be, everywhere and at all times, sufficient for the maintenance of themselves and families while in health, with a surplus to provide against the day of sickness, without their being under the debasing necessity of making application to their neighbours for relief. Persons so essentially useful to society should not merely support existence, but have the comfort of wholesome habitations, with sufficient space of ground to furnish them and their families with changes of proper vegetable food without much expense."

In an economic point of view, labour is an article of commerce as much as any other production. An excess of labour in a country will reduce the price, on the same principle as an excess of any kind of manufacturing or agricultural produce will do. On the other hand, a scarcity of labour will as inevitably enhance its price: because, where the labourer is free, and not bound to the soil or to the master, he can, under the circumstances, avail himself of the competition to obtain an advance of wages. In the present condition of society, however, in England, as the labourer, in consequence of the law of settlement, can hardly be called a wholly free agent, there are other considerations with an employer to prevent, in a great measure, the employed from reaping the benefit of competition, whilst he has all the disadvantages to bear from an excess of labour. Nor can the economic principles under which labour is brought by the laws of demand and supply, divest the labourer of those claims upon an employer springing out of the fact that, unlike other articles of merchandise—to which labour in the abstract is not unjustly compared—the labourer himself has an intrinsic, irrespective of the economic, value of his agency, and which entitles him to a consideration beyond the mere commercial remuneration for his brute labour. It arises out of his humanity, which, however low he may be in the scale of intelligence, raises him infinitely above every other class of being around him, and places him upon the same level platform with his employer.

This question begins to be much better understood, and more generally considered than formerly; and those employers who continue to treat their labourers as if they were cattle, or worse, form the exception, and not the rule. To "grind the faces of the poor,"* and extract from them the maximum of labour, whilst awarding them the minimum of wages, is no longer found to be good policy, if it ever was; whilst it is admitted that, as intelligent beings, capable of and possessing the same feelings, capabilities, and aspirations as other human beings, those qualities were not bestowed upon him to be crushed and annihilated, but to be cultivated and improved by moral training. Such is the state of the question between the employer and the employed; and we shall now point out some of those claims which the former is bound to consider, and to award to the latter.

* At the commencement of the present century it was no uncommon thing for the farmers of a parish, in order to evade the high price of labour, to put the labourers up to auction every Saturday night; when, by an arrangement amongst themselves, they thus obtained their workmen at from 6*d*. to 8*d*. a day, and the difference between that and the standard price of labour, which was from 2*s*. 6*d*. to 3*s*. per day, was made up out of the poor's rates; thus making the non-agricultural part of the parishioners pay their labourers. The writer could name two parishes in which, of his own knowledge, the farmers practised this detestable fraud for some years.

The first consideration, in the remuneration of a labourer, is that of his physical wants. His animal nature, and that of his family, require a certain amount of support, to enable him to sustain, without sinking, the arduous duties of his station. It is evident that it would be bad policy in a master to reduce wages so low as to incapacitate the labourer for properly and efficiently performing his work. On the other hand, as the supply of labour must necessarily be kept up, it is equally incumbent on an employer so to pay the labourer that he may rear a family in decency and respectability. Wages, therefore, of labour must, as a matter of economic consideration, embrace these two objects—the adequate support of the labourer and his family, so that the former may efficiently fulfil his duties, and the latter be reared in such a degree of comfort and sufficiency as to prepare them at a future period for similar duties.

The second consideration connected with his physical condition, is that of a decent and healthy habitation, which hitherto has been but little attended to by agriculturists, although it is perhaps of more importance to the moral and physical efficiency of a labourer and his family than anything else. Uncared for, the peasantry of England, generally, have been compelled to reside, huddled together in hovels, far worse in some instances than those provided for the cattle or pigs, and in which the sexes of the family are mingled in the most immoral and disgraceful manner, to the utter destruction of all decency of feeling in either the males or the females, and frequently leading to crimes of the most abhorrent character. Nor is the injury to the health of the labourer and his family less certain than that to his morals. For a whole family to be crowded up into one bedroom, scarcely large enough for the man and his wife, must be destructive of health, generating fever and other disorders, and incapacitating them for labour. Nor is it the least evil arising from the want of a decent and comfortable home, that the farm labourer is too frequently driven by its discomforts to the public-house or the beer-shop, where he learns to spend his money in dissipation, and moreover gets initiated into crime, as the testimony of all the judges and magistrates of the country goes to prove. Good policy, therefore, dictates to the employers of labourers, or the landowners, that they should—if they wish to lessen the amount of crime, and render their peasantry more efficient and more obedient to the laws—provide comfortable homes for them, so that they may have no, or at least less, temptation to spend their leisure time and their wages in enervating and enfeebling dissipation, and in acquiring those habits and practices which too frequently lead to crimes of the worst description. It has been deliberately asserted by country magistrates, as well as the judges of the land, that from eighty to ninety per cent. of the crimes committed in the rural districts have been concocted at the public-house or the beer-shop; and that if these were done away with, or otherwise controlled, the functions of the magistrate would almost cease. If, then, this cannot be done, let the landlords counteract their evil tendencies by making it desirable for the peasantry to spend their evenings at home, by providing such habitations for them as shall leave no inducement to look elsewhere for enjoyment.

But the labourer is a moral and intellectual being, however much these qualities have been neglected, and however low they may have ebbed for want of cultivation. It has been a maxim with many persons—themselves of cultivated minds—that to educate the peasantry is equal to making them above the law, and rendering them independent of all authority; that it would be putting a weapon into their hands, with which they would infallibly leave their proper sphere, and become unfit to fulfil the duties of their station. Such were the absurd ideas entertained by the country gentlemen of former generations, and by a few of the present day. But these antiquated ideas are becoming obsolete, and a more enlightened spirit and policy have supervened. The example of Scotland, where all the peasantry are educated, and are so far from being injured by it in their moral and industrial character, or elevated above their sphere of life, that they are the most obedient and industrious labourers in the United Kingdom, as well as the most enlightened and intelligent—has not been thrown away or overlooked. Many of our noblemen and gentry are exerting themselves in their several districts to raise the character of the peasantry around them, by education and other means of enlightenment, and by awarding premiums for good conduct.

When, however, we speak of education for the rural peasantry, we do not intend to confine that term to the mere mechanical arts of reading and writing. These, it is true, are considered the elementary parts of education; but, in point of fact, *of themselves*, they form only one part of that moral training which fits a man for fulfilling worthily the station in life to which he is destined. To render elementary instruction useful and efficient for all the more valuable purposes of life, it must be accompanied with an initiation into those moral and religious principles which constitute the basis of worth in society, and which alone can render the acquisition of the highest intellectual attainments otherwise than dangerous to the possessor. There never was a greater error committed by any government than that of enforcing a purely secular education, without any reference to the moral and religious parts of instruction. "The grand object," says a modern writer, "in educating the lower classes, should be to teach them to regulate their conduct with a view to their well-being, whatever may be their employments. The acquisition of scientific information, or even of the arts of reading or writing, though of the greatest importance, is subordinate and inferior to an acquaintance with the great art of 'living well;' that is, of living so as to secure the greatest amount of comfort and respectability to individuals, under whatever circumstances they may be placed."* The principles here pleaded for, should be instilled into the peasant's mind in early childhood, in order to have their full effect. It is therefore good economy for the agriculturist to take care that proper schools are established, in which such moral and religious training and instruction shall be given, as shall fit the future man or woman worthily to fill the station to which they may be destined.

The question of the secular education of the rural peasantry has of late years assumed a character of absolute necessity, in consequence of the extended and extending employment of machinery, and especially steam power, in agricultural operations. Although for the present it may be desirable, and even necessary, to employ skilled workmen and engineers in the management of the various machines now in use, it must soon occur to the mind of the farmer that he has a body of workmen at home, for whom it is both his duty and his interest to provide employment, and who are quite as capable of learning the proper method of conducting machinery as other men; and that all they want is a suitable education. He has therefore a powerful motive to qualify those around him for the employment which he is now compelled to entrust to a stranger; and the sooner the task is undertaken the better. The work is increasing beyond the ability or the qualification of the right workman to execute it; and a very few years

* "A Treatise on the Circumstances which determine the Rate of Wages and the Condition of the Labouring Classes," by J. R. Macculloch, Esq.

will bring about one of the most wonderful revolutions in the condition of rural affairs that can be conceived.

Such are the principal claims of the labouring classes upon their employers, whose interest is, in fact, as much concerned in their fulfilment as that of the peasantry themselves. When these claims, united with the system of cottage allotments and suitable habitations, are universally conceded, and not till then, the agriculture of the United Kingdom will become what it ought to be—a system of justice and equity; and country life will be a scene of universal happiness and enjoyment, so far as the events and casualties of life will admit of.

But the labourers, or husbandmen, have *their* duties to fulfil as well as rights to claim. The moral obligation is not all on one side; nor are the claims of the employer weakened or neutralized by those of the employed, although the latter may not be conceded to the full extent of their expectations. This is no excuse for a neglect of those duties, or the commission of those acts of injustice which are too common with the agricultural labourer. It is unfortunate for the character, as well as the welfare of this class, that the law of settlement, as now administered, is nearly equal to the system of serfdom, as it, in a manner, binds the labourer to his parish, and almost to one master, let the latter be as unjust and as brutal as he may. In this case, provided the employer keeps strictly within the verge of the law, the labourer has no redress, the magistrate having no cognizance unless the law is absolutely broken or set at nought. There is not a doubt but that this state of things has, in numberless cases, driven an ignorant labourer, who has never been under any kind of moral training, to the commission of offences; and while it forms no justification, at least fully accounts for his delinquencies.

Fortunately for the labourer, there are outlets of which he can still avail himself to seek employment, notwithstanding the stringent law which was intended to confine him to the parish in which he was born. These are the manufacturing establishments of the country, and emigration to the British colonies, or to the United States of America. The extension of the former has already absorbed a large portion of the rural populations; and an additional number have gone out to people the wild regions in those new countries, which are rising to social and political importance by the rapidity with which their wealth and populations increase. By these means the condition of those who remain in the country as husbandmen has been greatly improved, both by the advance in the price of labour and by the additional importance attaching to them in the estimation of the master—under the apprehension, that unless by a liberal treatment they can attach them to their present employment, they, too, will abandon their native country, and follow their former neighbours and friends to the New World.

We cannot be surprised at the unsettled condition of the agricultural labourers in many parts of the country when we consider the cruel harshness with which they are treated. In order to compel the peasants to leave the parishes where they reside, and thus lessen the poor's rates, many landowners pull down the cottages, and thus drive them to reside in neighbouring towns or villages where they can obtain a lodging, and from whence they return to their daily labour. On the contrary, many other noblemen and land proprietors have built comfortable cottages for their peasantry, with gardens attached to them. We have already referred to this subject, and instanced a noble duke as one of the foremost in this improved policy. The barbarity and short-sightedness of the former practice cannot be more powerfully illustrated than by contrasting the condition of the peasantry under it with those under the latter; and it is only astonishing that any man can be so destitute of the commonest principles of humanity as to sacrifice the comfort of his fellow-creatures, who are dependent upon him for subsistence, to the sordid and selfish desire of evading the payment of a just tax. Can we be surprised that the ignorant peasant should forget *his* duties, and seek by unlawful or unjust means to increase his comforts, that he should be profligate, and intemperate, and dishonest, when he sees that his landlord or employer makes no scruple of unjustly, although not illegally, depriving him of the shelter to which, as a native of the parish, he is morally and socially entitled?

Under such circumstances it is difficult, we admit, but not impossible, for the labourer to adhere to the straightforward path which it is both his duty and his interest to pursue. Nevertheless, it is equally true that the injustice of the master is no justification of a dereliction of duty in the servant. Whatever may be the treatment of the former, the latter, if he continues in his service, is bound by every consideration of right —though not of gratitude—to respect his property, to avoid wasting his time, to execute his orders with promptness and in the best manner in his power, and to treat him with that manly deference which their relative positions demand. On the other hand, his self-respect ought to teach him to abstain from those practices, which, while they waste his scanty wages—at best barely sufficient to support him and his family—lead him to forget every moral obligation due either to his employer, his family, or himself. He must avoid the public-house and the beer-shop as he would a pestilence, and as the source of nearly all the moral and physical evils with which the agricultural labourers are visited. Here it is that every scheme of dishonesty and illegality is concocted; here the poacher, the fowl-stealer, the wrecker, and the perpetrator of more serious crimes meet, not only to plan their schemes of plunder, and to divide and spend the produce of their criminal pursuits, but to employ every effort and every base argument to inveigle the young and unwary into their magic circle. They ridicule the idea of resting satisfied with the ordinary and scanty wages of labour, and boast that, with little effort and less danger, they can more than double their incomes, and be able, without starving their families and themselves, to enjoy the comfort of a cheerful glass and good company. And as to the danger of detection and punishment, it is only a short imprisonment, which, after all, is no great matter,* as the parish must in that case support the family.

Such are the arguments used by the old adepts in crime to seduce and ensnare the young, and which are too frequently successful. The encouragement held out to the poacher by the excessive preservation of game by the country gentlemen assists the delusion, and thousands of the rural populations are thereby led step by step into courses which end in the ruin of themselves and their families. It is the duty, therefore, of those who have the care of the education of the young peasantry to instil into their minds those principles that will lead them in after life to avoid those places and opportunities of dissipation and intemperance, of which the least evils are the pinching of their wives and children with cold and hunger, whilst they leave the men a prey to enticements which too frequently end in utter ruin, if not in the gallows.

* The writer once had a poacher in his employment who had been an inmate of every gaol in the county of N., and when asked which he liked best, candidly replied, he had no great fault to find with any of them; but if he preferred one more than another, it was that at W., as they treated a poacher like a gentleman!

SECTION VII.

POOR-LAWS.—TITHES.

If there is one truth in social ethics more potent than another, and which has obtained in all ages, and in all countries of the world, it is this—that *"the poor will never cease out of the land."* It matters not what form of government a people may exist under, what may be the richness and productiveness of the soil, what the extent and value of its commerce and manufactures, or what the industry and application of the inhabitants—such is the constitution of man, and such the construction of human society, that there will still be a class whose destitute condition claims for them the sympathy and help of those who by a more fortunate arrangement of the circumstance of life are in a more favourable and prosperous state, and whose duty it is to administer to the wants of their indigent fellow-creatures.

When, however, we speak of poverty, we do not imply merely the want or absence of wealth, or what is called competency. Although the possession of this is generally considered to constitute riches, it does not absolutely render a man rich. In point of fact, one man may be poor though in possession of a valuable estate, whilst another may be rich that seldom has a sovereign in his pocket, or is in the enjoyment of any of the luxuries of life. Neither of these are absolutely poor while they can obtain a sufficiency of the necessaries of life, the want of which, and the inability to obtain them, being what constitutes the condition of poverty.

"A man's life consists not in the abundance of the things which he possesseth," but in the enjoyment of those advantages which the goodness of Providence has bestowed upon him as the fruits of his labour, or the results of the circumstances in which he has been placed. In this sense, the husbandman with his 12*s*. or 14*s*. a week may be as happy, and therefore as rich, as the master whom he serves; and, on the other hand, the nobleman who numbers his acres by thousands, and his menials by hundreds, may, in reality, be poorer than the humblest labourer who works upon his land.

Poverty, therefore, in the abstract, is the inability—whether from misfortune unavoidable, or mismanagement, or imprudence, or profligacy, or crime—to obtain the necessaries of life; and the poor, whatever may have been the cause of their destitution, may demand, by reason of their humanity, that assistance from society which their abject condition requires. This, and this alone, is the basis and the object of all legislation on the subject of the poor.

Without going into the remote history of the state of society previous to the Norman conquest of Britain, the state of serfdom which existed, necessarily produced a large amount of physical suffering, and absolute want of the necessaries of life, rendering the assistance of others indispensable. After the conquest, the strictness with which the feudal system was established and enforced increased the number of those who, whilst they toiled for their daily bread, were continually liable to casualties which reduced them to poverty. For the relief of these there were no legislative or compulsory enactments imposed upon the wealthy classes; but as the *villeins* or serfs were at the uncontrolled disposal of their masters or lords, and could be transferred by deed, sale, or conveyance from one owner to another, there was a general understanding based upon custom, and arising out of the common feelings of humanity, that the lord should provide for his villeins in cases of sickness or other accidents that incapacitated them for labour.

But although the immediate effect of the conquest was to increase the amount of serfdom as the consequence of the transference of the land from the Anglo-Saxon to the Norman lords, no new slaves were allowed to be introduced by means of captives taken in war; and this is considered to have ultimately had the effect of abolishing slavery altogether, by causing it to die out for want of a fresh supply. It is recorded by ancient writers that in the twelfth century a law was enacted in a great council at Westminster to the following effect:—"Let no man for the future presume to carry on the wicked trade of selling men in market like brute beasts, which hitherto hath been the common custom of England." *

The clergy of the Church of Rome frequently induced the lords to enfranchise their slaves. "Temporal men, by little and little, by reason of that terror in their conscience, were glad to manumitte all their *villeins*; but," adds the historian, "the said holy fathers, with the abbots and priors, did not in like sort by theirs, for they had not conscience to impoverish and dispoyle the church so much as to manumitte such as were bound to their churches, or to the manors which the church had gotten, and so kept theirs still." "Indeed, such numbers were in their service that no less than 2,000 villeins belonged to some of the richest abbeys."†

Gradually the state of villeinage merged into that of servile tenants, allowed by their owners to occupy small portions of that part of their estates which lay farthest from the mansion, on condition of rendering certain services, such as reaping the lord's corn, cleansing his fish-ponds, &c. While not thus employed in his lord's service, the serf was allowed to work for his own benefit, either on his own land or for others at wages. The introduction of the woollen manufacture into England in the fourteenth century (1331), under the sanction and support of King Edward III., helped the process still further by increasing the riches of the people in towns, while the owners of land were in comparative poverty; and the freedom enjoyed by those engaged in mercantile or trading pursuits being accompanied with a superior mode of living, rendered the villeins discontented with their bondage, and led them to combine for the purpose of compelling their lords to grant them manumission. Many of them fled into the towns, where they were received and protected by the manufacturers and merchants, who found employment for them. Those who remained were emboldened to treat their masters so insolently that they were afraid to exercise their power over them for fear of losing them altogether.‡ By this means were the villeins converted into free labourers.

The dreadful pestilence which occurred in England in 1339, by decimating the rural population, rendered those who survived more alive to a sense of their value and importance to their lords. "The Statute of Labourers," passed in the reign of King Edward III., while it gives a good idea of the value of labour, serves also to show that the free labourer was not a rare or strange being, and that their numbers were sufficiently large to render them an object of legislation; and although the statute was enacted in consequence of the labourers taking advantage of the scarcity of hands

* Eadmer, vol. iii. p. 68.

† Sir F. M. Eden, "State of the Poor," vol. i. p. 11.

‡ Ibid., p. 30.

created by the pestilence to demand double wages, it also prevented the employers from reducing them below the standard fixed by the statute.

It is evident that with the abolition of villeinage and the introduction of free labour, the obligation of the lord to support his former bondsmen ceased, and that the latter were thrown, so far as compulsory support was concerned, upon their own resources. The poor, therefore, in those days had lost with their servitude that aid in sickness or other casualties on which they could rely when bound to their lords. In this case, however, the clergy stepped in and supplied the deficiency by raising funds, in virtue of their sacred character, for the purpose; and previous to the time of Elizabeth they and the convents were the almoners of the public. Independent of these, however, many benevolent individuals made permanent provision for the indigent poor, while others were induced to do the same in expiation of some crime, or for the repose of the souls of their friends. Still, the ecclesiastical body were the chief support of the indigent poor, and by their exhortations—in some cases amounting to command—obtained large sums for that purpose; and not only this, but one third of the livings of the clergy were by law reserved expressly for the support of the poor, so that there was, in fact, a compulsory provision, although no legislative enactment to enforce it.

The rupture between Henry VIII. and the Pope, or the Church of Rome, completely changed the course of things relating to the support of the poor. The convents had, heretofore, been the mainstay of that class, and their suppression cut off their chief dependency. Independent, however, of those who were reduced by reason of old age, sickness, or other unavoidable misfortunes, there was a class of sturdy beggars, who roamed the country in a kind of semi-religious character, making a merit of poverty, and claiming by virtue of a vow the charity of the wealthy. These idle vagabonds were patronised by the convents and the Romish clergy in England just the same as they are in Spain and other Catholic countries at the present day. But the Reformation cut off the resources of these also, and they could no longer resort to the convents, and there claim the aid which the monks were only too willing to accord to them. In future they must depend, while tolerated, on the eleemosynary assistance of those who still adhered to the Romish faith; but the progress of the Reformation soon drove them either into foreign countries, or to change their habits, and seek by labour to gain an honest livelihood. There was, therefore, from that time, only the really indigent poor for whom a provision was necessary, and these were placed by the Reformation in the most helpless condition.

The clergy of the Establishment were now the principal almoners of the voluntary contributions, on which alone the poor were supported. Their appeals to their parishioners were frequent and urgent; and during the reign of Henry VIII. several notices of the condition of the poor were to be found in the records of parliament. The means, however, raised for the poor were found to be utterly insufficient; and so urgent did the case become, that in 1601 the compulsory act of the 43rd Elizabeth was passed, which continued the law, with but few modifications, for two hundred and thirty years, and until the present poor-law was passed in the third and fourth years of the reign of William IV.

This act of Elizabeth arose out of a pressing necessity. The voluntary source of support on which the poor relied after the Reformation was nearly dried up, as we may gather from the frequent, urgent, and even menacing appeals of the clergy, and their reproaches of their hearers for their remissness in giving their money. This was the necessary and inevitable consequence of its being left to every one to give or not, as it suited his purpose. People prefer knowing what are the real moral and legal claims upon them, rather than to have those claims constantly brought before them, without any definite knowledge of the amount to which they are amenable, or even of the precise account of the manner in which they are disposed of. The act, therefore, of the 43rd of Elizabeth was accepted by the public as a fair, as well as a necessary, arrangement, by which all persons would be called on to contribute according to their circumstances, as shown by a *primâ facie* view of their position in society.

But there was a moral as well as a social necessity for the act. In consequence of the system pursued by the clergy and the convents, of entertaining those who were under a vow of poverty, but who were in fact too idle to work, swarms of lazy beggars infested the towns and villages upon the suppression of the monasteries, who preyed upon the industrious without scruple, and, as of yore, demanded that relief to which they assumed that their position and character for sanctity gave them a claim. But the spell was broken, and people began to question the right of these sturdy beggars to live at the expense of their industrious neighbours, destitute, as they in general were, of a single qualification that could entitle them to relief. The act, therefore, of the 43rd of Elizabeth at once put a stop to this system, and instead of receiving the eleemosynary relief they demanded, they were referred to the officials appointed under the act, who soon gave them to understand that *they* were not the persons who could claim the protection under its provisions. Nor was this all; for such persons had been taken cognizance of by an act passed in 1530, which divided beggars into two classes, namely, the aged and impotent, and vagabonds and idle persons. The first were licensed by the magistrates, in letters under seal, to beg within a certain precinct, as they should think they had most need. These were registered and certified at the quarter sessions; and if they begged out of the prescribed limits they were liable to be set in the stocks for two days and two nights, and fed on bread and water; and a similar punishment was inflicted upon them for begging without a licence.

But upon those beggars who were capable of working a much more severe punishment was inflicted. "Every vagabond, whole and mighty in body, who should be found begging, and could give no account how he got a living, was to be tied to a cart's tail and whipped till his body was bloody by reason of such whipping; and then sworn to return to the place where he was born, or last dwelt for the space of three years, and there put himself to labour." And in an act of the 27th of Henry VIII., c. 25, a still more severe punishment was inflicted upon those termed "*rufflers*" (noisy, boisterous fellows), and "*valiant* beggars." For the first offence they were simply whipped and sent home, as above stated; but for the repetition of it, they were again to be whipped, and have the upper part of their right ears cut clean off, and then sent home, as on the first occasion.*

This act appears to have been an imperfect attempt to establish a compulsory support of the indigent poor; for it not only calls upon the people to subscribe their money for that purpose, but it directs *all* official persons, both in cities, towns, and villages, to collect alms from benevolent persons, and to dispense them "in such good and discreet wise as that the poor, and others not able to work, may be provided, holpen, and relieved, so that none of them in no wise be suffered to go openly in begging."† The clergy, particularly, were enjoined by this act to aid by sermons, collections, biddings of the

* Sir F. M. Eden, vol. i. p. 87. † Ibid. vol. i. p. 85.

beads, as in times of confessions, and at the making of wills or testaments of any persons, at all times of the year, in calling on the people to be liberal in giving their money from time to time towards the comfort and relief of the said poor, impotent, decrepid, indigent, and needy people, and for setting and keeping them at work.*

The above enactments, be it observed, were prior to the Reformation, from which it would seem that notwithstanding the encouragement given to begging by the monastic system, the evil had grown to such a height as to call for a measure to check it. "Among other bad effects," says Sir F. M. Eden, "which attended the monastic institutions, it was not perhaps one of the least (though frequently esteemed quite otherwise), that they supported and fed a very numerous and idle poor, whose sustenance depended upon what was daily distributed in alms at the gates of the religious houses. But upon the total dissolution of these, the inconvenience of thus encouraging the poor in habits of indolence and beggary was quickly felt throughout the kingdom; and abundance of statutes were made in the reign of King Henry VIII. for providing for the poor and impotent, which, as the preambles to some of them recite, had of late years strangely increased."† Even before the Reformation, the monasteries became alarmed at this increase, and complained of it to the king so early as the time of Henry III. But the system naturally engenders beggary; to be convinced of which, any person has only to go to those countries in which the Roman Catholic religion, and consequently, the monastic system, prevails. There they will see swarms of sturdy beggars, of all ages, and of both sexes, whose only mode of living is the bounty of the charitable, who deem it a religious duty to give to them without any consideration of the merits of the case.‡

It may be supposed that the breaking up of the monastic system, by which the sturdy vagrants who had been supported by them were thrown upon their own resources, would naturally produce a great amount of crime; and we find that in the latter part of the reign of Henry and that of Elizabeth, every part of the kingdom was infested with vagabonds and robbers. To suppress these, the most stringent laws were enacted and put in force. Such was the severity with which these laws were executed, that it is said that 72,000 great and petty thieves were put to death during the reign of Henry VIII.; and even in that of Elizabeth, "there was not one year, commonly, wherein 300 or 400 of them were not devoured and eaten up by the gallows in one place or other." In Somersetshire (as is related by Strype), in the year 1596, only five years before the statute of the 43rd of Elizabeth, "forty persons had been there executed in one year for robberies, thefts, and other felonies; thirty-five burnt in the hand; thirty-seven whipped; 183 discharged: that those which were discharged were most wicked and desperate persons, who never could come to any good, because they would not work, and none would take them into service; that notwithstanding these great numbers of indictments,

* Sir F. M. Eden, vol. i. p. 84.

† Ibid., p. 95.

‡ The refrain of the old song would seem to intimate that the professional beggar was quite an independent character in his way; and, we are bound to say, it is too much the case in the present day:—

"Of all the trades in London a beggar's is the best,
For when a man is weary, he sits him down to rest.
And a begging we will go, will go, will go,
And a begging we will go!

"I've a bag for my oatmeal, another for my salt,
And a little pair of crutches just to see how I can halt.
And a begging," &c., &c., &c.

the *fifth part of the felonies* committed in the county were not brought to trial, and the greater number escaped censure, either from the superior cunning of the felons, the remissness of the magistrates, or the foolish lenity of the people; that the rapines committed by the infinite number of wicked, wandering, idle people were intolerable to the poor countrymen, and obliged them to a perpetual watch of their sheepfolds, pastures, woods, and corn-fields; that the other counties of the kingdom were in no better condition than Somersetshire; and many of them were even in a worse; that there were, at least, 300 or 400 able-bodied vagabonds in every county, who lived by theft and rapine; and who sometimes met in troops to the number of sixty, and committed spoil on the inhabitants, and that the magistrates were overawed, by the associations and the threats of confederates, from executing justice on the offenders."*

Such was the desperate condition of the country as revealed by the dissolution of the monastic orders and the suppression of religious houses, to the existence of which a large portion of this disorder may justly be ascribed. The indiscriminate relief they afforded, the sanction they awarded, *on principle,* to vows of voluntary poverty by laymen, and the existence of orders of begging friars, are quite sufficient to account for the large numbers of "valiant beggars" who infested the country, and preyed on the industrious when they found their eleemosynary resources cut off, and themselves driven to find out other means of securing a livelihood. Accustomed to an indolent life, they were too lazy to work; and, therefore, when no longer permitted to beg, they took to more violent courses, which ended by leading them to the gallows.

Another cause however existed, which rendered the condition of the honest and industrious labourers more difficult. This was the increasing wealth of the country in consequence of the influx of the precious metals after the discovery of America, and the conquest of Mexico by the Spaniards. This circumstance made no alteration in the price either of labour or provisions for nearly a century after it took place. The reason of this was, that Spain took such precautions to keep the supply of gold and silver to herself in the first instance, that other nations of Europe profited but little by the discovery. But when, through the increase of riches, the Spaniards began to relax in their industrial habits, they by degrees found themselves compelled to obtain from other countries those manufactured goods, which previously were the produce of their own looms. Thus, the city of Seville alone, when the conquest of Mexico and Peru had opened fresh markets for Spanish goods, employed 16,000 looms; but in a few years, so completely were the habits of the people changed, that the looms numbered only 300, and the merchants were compelled to go to England, France, and Holland for those articles, which their own countrymen could no longer supply to them. The following table shows the gradual advance in the prices of wheat and labour at the different periods specified.

AVERAGE PRICES OF WHEAT AND LABOUR FROM THE YEAR 1400 TO 1800.

	Wheat, per quarter.			Labour, per day.		
	£	s.	d.	£	s.	d.
From 1400 to 1500	0	6	$7\frac{1}{2}$	0	0	$6\frac{1}{2}$
„ 1500 „ 1600	0	17	$5\frac{1}{2}$	0	0	$6\frac{1}{2}$
„ 1600 „ 1700	2	3	8	0	0	$10\frac{1}{4}$
„ 1700 „ 1800	2	6	$6\frac{1}{2}$	0	1	3

Thus, whilst wheat had advanced from 600 to 800 per cent., labour had not advanced more

* Strype's "Annals," vol. iv. p. 290.

than 150 per cent. This alone will help to account for the large increase of pauperism in England. For, although during the sixteenth century the price of wheat had only risen 200 per cent., that of labour had not advanced at all. And this state of things became still worse the next two centuries; and the same disproportion between the price of the necessaries of life and that of labour has continued up to the present time. It is very plain that the labourer was far better off in the fifteenth century, when wages were only 6½*d.* per day, than when, in the eighteenth, he was receiving 1*s.* 3*d.* per day. In the first case his wages were equal to nearly three pecks of wheat per day; but in the latter they would scarcely purchase one peck. We have, therefore, quite causes enough to account for the necessity existing at the commencement of the seventeenth century for the enactment of the 43rd of Elizabeth for the maintenance of the indigent poor, to the consideration of the working of which we shall next address ourselves.

It is a fact well known to those who are acquainted with the history of the agricultural labouring class, that up to a certain recent period—say about the year 1800—persons of that class were the last to avail themselves of the legal provision secured to them by the law of Elizabeth. Many circumstances existed to account for this reluctance. In many respects the poor were well off; for, in addition to their weekly wages, there were the commons, on which they could keep a cow and a few geese, which helped to support their families in comparative comfort. Besides this, the industrious labourer was not the lowest step in the scale of society; there was always a class who, by their improvidence and dissipation, placed themselves out of the pale of regular employment, and it was not allowable that these should starve. The workhouse, therefore, was their regular place of resort when they could not procure other means of support. This circumstance rendered parish relief still more odious to the industrious man, who, generally speaking, would make any shift rather than apply to the overseer for relief, in common with the thriftless, the drunkard, or the dishonest, who in many cases were the constant inmates of the poor-house when work was scarce.

But when, at the beginning of the present century, and during the war with France, the price of all kinds of provisions rose to an enormous height, and everything used in housekeeping kept pace with it, it became necessary, in order to increase the production, to enclose the commons, and bring them under cultivation, which still further curtailed the resources of the labouring poor. The consequence was, that such was the distress amongst them, especially those who had large families to support, that the spirit of independence for which the peasantry of England had previously been distinguished was broken down. Deficient harvests heightened the calamity brought upon the country by the war; and out-door relief was administered to such an extent, that a regular scale of allowance was fixed by the magistrates to be given to those who had families, according to the number of their children. It may be imagined that under such a system not only did the poor-rates become enormously heavy,* but the whole body of the peasantry were reduced to distress; and acting upon the old snatch of the song—

> "Hang sorrow and drive away care;
> The parish is bound to maintain us,"—

they no longer hesitated to receive relief from the parish, but, on the contrary, the

* The writer was on a farm in Norfolk at that period, the poor's rates of which were exactly equal to the rent, *i.e.*, £350 a year. One of his labourers, who had eight children, received by order of the magistrates 20*s.* a week, from the rates, besides his wages, which were half-a-crown a day.

object was to obtain as much as possible by fraudulent means. Such impositions always accompany the disposition to live at ease without labour; and the difficulty of detecting them arises from inability to devote the time necessary for inquiry, and the indolence or indisposition of those whose duty it is to take the trouble of doing so. At the period of which we are now writing, the magistrates throughout the country appear to have been actuated by a conviction that it was impossible for a man to maintain a family by the wages he received for his labour, and they therefore acted upon that principle. Single men they left to shift for themselves, unless in times of sickness, or when unable to procure work. But all the married men were allowed so much a-head for himself, his wife, and each of their children, which system, in fact, was nothing less than paying the just wages of the farm labourer out of the poor's rates to the injury of those who had no land, but were equally assessed.

But the great evil arising from the system was the injury done to the poor themselves by thus accustoming them to receive gratuitous relief. "A law of this kind," says a modern writer, "would obviously render all those who by their exertions could at the utmost earn but a bare subsistence averse to industry, which in such a case would be a sacrifice of ease without any increased advantage. If present industry were rendered useless, so would thrift and forethought become a folly, an abandonment of present enjoyment without an object. Every present indulgence that the law allowed would wisely be enjoyed; good moral habits and bodily skill would have little merit, if the law should place those with them and those without them in the enjoyment of the like benefits. What appears desirable for a man's advantage, it is a virtue in him to do also for his children. The pauper's progeny would be themselves paupers, and the law would present to them *every* inducement to beget other paupers, and *no* inducement to refrain. Such we have seen the English pauper—slothful, thoughtless but of his parish pay, sometimes living to see three generations of his progeny paupers, like to, or worse than, himself." *

There can be no question of the rapid demoralization of the working classes under such a system, rendered necessary under the old law after the peasantry had been deprived of the advantages they once enjoyed in the exercise of common rights, and the price of provisions had risen to so alarming a height during the war. The evidence adduced before the commissioners of inquiry are sufficiently explicit on that head. "We have cases of three generations of paupers in the house at once," says one witness, "relieved at the rate of £100 a year." A clergyman in Cumberland speaks of the practice of that county: "A very different description of women have of late years become the mothers of bastard children. Formerly it was confined to the daughters of cottagers, and girls employed in farm husbandry; but of late, *very respectable farmers' daughters* have been in that situation, and have applied to have their offspring taken care of by the parish:" An overseer states, "We, at this time, in our parish, are supporting two bastard children, *whose mothers have landed property of their own*, and would not marry the fathers of their children." Another says, "The daughters of *some farmers, and even landowners* have bastard children. These farmers and landowners, and children with them, regularly kept back their poor-rates to meet the parish allowance for their daughters' bastards."†

* "Encyclopædia Britannica," article Poor-Laws.

† See Report of Commissioners of Inquiry, &c.

That the working of the act of the 43rd Elizabeth was as bad as it could possibly be, for nearly half a century previous to its repeal, there cannot exist any difference of opinion, and the declaration of Lord Brougham that unless the system was abolished it would soon absorb all the landed property of the kingdom, was fully justified by the annual increase of the sums raised for the relief of the poor. Whatever wages the labourer received, not one in fifty ever thought of laying by against a time of sickness or slackness of work. One case in the Bedford level is recorded, in which the earnings of the labourers amounted to from £60 to £70 a year; but upon a stoppage of works by a frost, and generally from November till March, almost every labourer came on the parish. When the farmers remonstrated with the magistrates upon these facts the reply was, "Why, what are we to do? they spend it all, and then come and say they are starving, and we must relieve them."

In the northern division of Devonshire, "the practice of granting allowance for children is so general and confirmed, that the pauper is in the habit of giving formal notice to the overseer of the pregnancy of his wife. Should the overseer refuse the application for the fixed sum allowed for the second, third, or fourth child, the magistrate's single inquiry, on his appearance before him under a summons, would have been as to the custom of the parish or the hundred. 'At what number does allowance begin with you?' was the common mode of putting the question, as I was repeatedly assured by overseers. The previous or present earnings of the pauper, or of any of his family, *were never mentioned*."*

"At Freston, in Suffolk, Mr. Stuart stated that 'a child is entitled to relief at the rate of 3*s*. a week, on his own account, from the age of fourteen.' At Bettisham, in Cambridgeshire, a boy of sixteen receives 2*s*. 6*d*. for the week; he lives at home with his father; the family consists of his father, mother, brother, and himself. Seventeen is the age at which a young man is entitled to separate relief as an unemployed labourer. His pay then is 3*s*. 6*d*. The allowance to our single young men out of employ used to be 2*s*. 10*d*., according to the scale of four quartern loaves, price 8½*d*. Last November they came in a body to the sessions, and complained to the magistrates of the insufficiency, and it was then raised to 3*s*. 6*d*. This sum they received when above a certain age, although residing with their families." †

By the act 43rd Elizabeth it was not lawful to afford relief to any but the impotent, except in return for work; but this part of the statute appears to have been greatly neglected; "according to the returns for the year 1832, out of £7,036,968 expended, only £354,000, scarcely one-twentieth part, was paid for work, including work on the roads and in the workhouse." The reasons for this were, that the task of finding work for the pauper was more troublesome and difficult to the overseers than gratuitous relief; that wherever work was to be paid for, there must have been superintendence, but where paupers were the work-people much more than the average degree of superintendence was necessary (it will be easily anticipated that the superintendence was very rarely given, and that in far the greater number of instances in which work was professedly required from paupers, in fact, no work was done); that collecting the paupers in gangs for the performance of parish work was found to be more immediately injurious to their conduct than even allowance or relief without requiring any work at all. Whatever might have been the general character of the parish labourers, all the worst of the

* Report, &c., p. 31. † Ibid.

inhabitants were sure to be amongst the number; and it is well known that the effect of such an association is always to degrade the good, not to elevate the bad. The interference of the magistrates in these cases was always injurious. "Under the idea of compelling the able-bodied pauper to find work for himself, they restricted the hours of labour for the parish to four or five. This half-work, half-idle kind of life, while the pauper was sure of his allowance from the parish, whether he worked or not, produced the worst but necessary effects; such men became the worst in their several parishes, and were always found ready to join in any scheme of riot or disturbance, or of dishonesty, that might be suggested to them: and yet, in many instances, these paupers received more wages than the industrious poor. At Eastbourn, in Sussex, for instance, the average of wages for hard labour was 12*s*. a-week, whilst the paupers received for their nominal labour 16*s*. a-week. Two families received in the year ending Lady Day, 1832, £92 4s., or nearly 17*s*. 9*d*. per week each! No wonder that the wives of the independent labourers regretted that their husbands were not paupers."*

It is impossible to conceive of a system more calculated to demoralize the whole body of the peasantry of a country than this. By it the idle and dissolute were placed in a condition of material comfort above the industrious independent labourer; and, with a very imperfect training, it is not likely that the latter should be able to resist the contaminating influence, and desire to share in the bounty thus awarded to his fortunate neighbour. And this process was accelerated when by illness, or some other casualty, the independent labourer was compelled to have recourse to the parish allowance. In such cases his spirit broke down at once, and his independence was gone. His former reluctance to subject himself to the ignominy of pauperism gave way to the indifference of confirmed dependence upon parish relief; and when again at work for his regular employer, he felt that the stimulus to industry and good behaviour was gone, and he became as reckless and careless of pleasing as others, with whom he had been associated in his period of abstraction from his regular labour. Early marriages, too, were encouraged by the system. The single man, even as a pauper, was allowed barely sufficient to support life; but directly he married his prospects brightened. One child was an advantage, but every succeeding one was doubly so. With three, his wages from the parish were more than equal to the pay of an industrious independent workman; with half-a-dozen, he arose to the dignity of being entitled by "justice's law" to 16*s*. a-week, with or without work. "It appeared to the pauper that the government had undertaken to repeal in his favour the ordinary laws of nature; to enact that the children should not suffer for the misconduct of their parents, the wife for the husband, or the husband for that of the wife; that no one should lose the means of comfortable subsistence, whatever might be his indolence, prodigality, or vice: in short, that the penalty which, after all, must be paid by some one for idleness and improvidence, should fall, not on the guilty person or on his family, but on the proprietors of the lands and houses encumbered by his settlement. Can we wonder if the uneducated were seduced into approving a system which aimed its allurements at all the weakest parts of our nature, which offered marriage to the young, security to the anxious, ease to the lazy, and impunity to the profligate?"

The reasoning in the above paragraph is abundantly borne out by the evidence given before the Commission of Inquiry, from which we select two cases. "The answers given

* Report, &c., p. 39.

by the magistrates when a man's bad conduct is urged by the overseer against his relief, is, —"We cannot help that; his wife and family are not to suffer because the man has done wrong." . . . . "And whereas it appears that the wife of the said Robert Reed is now confined in the House of Correction at Cambridge, and that he is put to considerable expense in providing a person to look after his said four children, we do therefore *order* the churchwardens and overseers of the poor of the said parish, or such of them to whom these presents shall come, to pay unto the said Robert Reed the sum of *eleven shillings weekly*, and every week, for and towards the maintenance and support of himself and family, for one month from the day of the date hereof. Given under our hands and seals this 20th day of February, 1833."*

The statute of the 43rd of Elizabeth was certainly not answerable for all this abuse of the power of paying the idle and profligate out of the labour of the industrious. Undoubtedly the state of the country was widely different at this period from what it was when the poor-law was first instituted, and that extensive alterations were requisite to make it square with the times. But everyone who looks at the question now, at a distance, must condemn the manner in which the law was constituted and carried out, —by which all that were bad of the rural population were encouraged, and the industrious made to contribute to their profligacy, whilst all that were honest and industrious amongst the peasantry were left to their shifts to get through as they could. The system of out-door relief, in fact, as administered by the magistrates during the last thirty years of the existence of the statute of Elizabeth, was an exaggerated imitation of the practice of the monasteries—an indiscriminate distribution of the funds of the parish to all who applied for them, without reference to character or the means possessed by the applicant to maintain himself. The statute neither contemplated nor admitted of such a system as this, but provided that only the indigent and impotent should be relieved. The provisions of the statute were—"First,—to afford necessary relief to the lame, impotent, old, blind, and such other among them being poor and not able to work; and, secondly, to provide work for such as are able, and cannot otherwise get employment." For these purposes, the overseers of the poor were empowered to raise funds in each parish sufficient for the maintenance of the poor. Such is an abstract of the intentions of the statute which placed the distribution of the funds in the hands of the overseers, assisted by the parishioners assembled in vestry; but latterly the magistrates took the power of distribution from both, and they who raised or paid the money were deprived of the control the act gave them of discriminating between the really and the fraudulent poor. The practice, in fact, was opposed both to the letter and the spirit of the statute, and was as destructive to the morals as it was to the industrial habits of the labourer, and to the interest of the rate-payers.

The only excuse that can possibly be given for this is the unprecedented state into which the country was thrown by the war, and the consequent high price of provisions, without a corresponding rise in the rate of wages. This latter also wants explanation. In the valuation of a farm before hiring, it was usual for the valuers to estimate the rent of the land by the amount of the poor's rate rather than the price paid for labour. It was therefore the interest of the farmers that the latter should be low and the former high; for the magistrates, as if to forward this view of the case, drew out a scale of wages according to their own estimate of the value of labour; and every labourer

* Report, p. 59.

receiving less than the scale was entitled to have it made up to him out of the poor's rate, upon the party showing that he depended solely on his wages for the support of himself and his family. This disastrous system, which opened the door to so much fraud on the part of the rate-payers (or rather the agriculturists, for they instantly availed themselves of it to reduce the rates of wages), originated with the Berkshire magistrates, with benevolent, undoubtedly, but shortsighted motives, to compel the farmers to pay their labourers wages in proportion with the price of bread. It had directly the opposite effect; for it lowered wages and increased the poor's rates, at the same time destroying the independence and moral feeling of the whole body of the rural peasantry. An anonymous writer, commenting on this system, says, "It is evident that under it, unless a man does work enough to get higher wages than those of the allowance system, he may (as regards the amount of wages) just as well do no work at all, for all that he gets will be deducted from his allowance, whereas every hour's hard work ought to better a man's condition."

The only persons, indeed, who suffered under the system were the very men for whose benefit the act was supposed to have been passed—the labourers and their families. Prudence and forethought in them were punished instead of being rewarded. A man with a large family was, by common consent among the rate-payers in rural districts, employed so as to keep his family from being placed upon the poor-rates, rather than the single man, or him who had no family, or who had the means by labour, or otherwise, of supporting himself. Piece-work was refused to the single man, or to the married, if he had any property, because they could exist upon day wages; it was refused to the active and intelligent labourer because he could earn too much. If he left his parish and sought work where there was a demand for labour, he was driven back—however much he and his new employer might suit each other—by some parochial expedient against *non-parishioners*, to his old home to receive as a pauper perhaps 6*d*. a day at road-work, at which he might laze away his time and acquire habits that would place him on a level with the lowest of the paupers, to which the miserable pay reduced him in his own estimation.

The actual effect of this system was that the agricultural labourers were brought to look upon prudence, industry, and economy on their part as objects of punishment by their masters, while recklessness and improvidence entitled them to support and consideration. The former, suffering under an undeserved ban, and restricted by the unjust practice of the parish authorities, became, in their turn, reckless; and, to make up an income adequate to their necessities, took to poaching, or fowl stealing, or other unlawful acts, to which so many of the peasantry have resorted, and which swell the number of criminals at the county assizes or the quarter sessions in the country. It will require two or three generations of this class to eradicate the monster evils of the administration of the old poor-laws, and to convince the peasantry that the new law, if duly submitted to by them, and humanely and properly administered by the authorities, is calculated to raise him in the scale of moral and social importance as a part of the national family.

The Commission of Inquiry into the working of the poor-law was appointed by parliament in the year 1831, and during its sitting a body of information was elicited from the evidence given before it of the most valuable and convincing character, and its report is considered one of the most masterly and conclusive documents ever presented to the legislature. The evidence went to prove that the mode adopted of giving relief raised the pauper and depressed the independent labourer, and that the effect had been to cause the latter to abandon his position and character, and place himself on a par with the former. Thus the parish, as the best paymaster, was become the first instead of the last resource. They therefore recommended that any legislation on the subject should, above all, reverse the order of things, and place the two classes in their proper position; that is, the pauper below the independent labourer. The report contemplated no changes in the principle of the ancient poor-law—the alterations proposed by them relating rather to the appointment of more responsible agency, to assist and control that which had been found so inefficient except for evil. This was the only addition to the principle of the statute of Elizabeth; but some useless or injurious parts of the law—which although adapted possibly to the times in which they were adopted, had become no longer so—were repealed.

The committee recommended, "First, that, except for medical attendance, and subject to the exception respecting apprenticeship, all relief whatever to able-bodied persons, or to their families, otherwise than in well-regulated workhouses (*i. e.* places where they may be set to work according to the spirit and intention of the 43rd of Elizabeth), shall be declared unlawful, and shall cease, in manner and at periods hereafter specified, and that all relief afforded in respect to children under the age of sixteen shall be considered as afforded to their parents."*

The reason offered for what has since been termed "the workhouse test," was, "that it is demoralizing and ruinous to offer to the able-bodied of the best characters more than a simple subsistence." The person of bad character, if he be allowed anything, could not be allowed less. By the means which we propose, the line between those who do and those who do not need relief, is drawn, and drawn perfectly. If the claimant does not comply with the terms on which relief is given to the destitute, he gets nothing; and if he does comply, the compliance proves the truth of his claim, namely, his destitution. If these regulations were established and enforced with the degree of strictness that has been attained in the depauperized parishes, the workhouse doors might be thrown open to all who would enter them and conform to the regulations. Not only would no agency for contending against fraudulent rapacity and perjury, no stages of appeal (vexations to the appellant and painful to the magistrates), be requisite to keep the able-bodied from the parish, but the intentions of the statute of Elizabeth, *in setting the idle to work,* might be accomplished, and vagrants and mendicants actually forced on the parish—that is, forced into a condition of salutary restriction and labour. It would be found that they might be supported much cheaper under proper regulations than when living at large on mendicity and depredation.† "Little need be said on the next effect of the abolition of partial relief—in drawing a broad line of distinction between the paupers and the independent labourers. Experience has shown that it will induce many of those whose wants arise from their idleness, to earn the means of subsistence; repress the fraudulent claims of those who have now adequate means of independent support; and obtain for others assistance from their friends, who are willing to see their relations pensioners, but would exert themselves to prevent their being inmates of a workhouse."‡

The recommendations of the commissioners were adopted, with some slight modifica-

* See Report, pp. 261, 262.

† Ibid., p. 264.

‡ Ibid., p. 276.

tions, by the legislature, as was also the second specific measure of a "central board, to control the administration of the poor-laws, with such assistant commissioners as may be found requisite. And the commissioners shall be empowered and directed to frame and enforce regulations for the government of workhouses, and as to the nature and amount of the relief to be granted and the labour to be exacted in them; and that such regulations shall, as far as may be practicable, be uniform throughout the country."* Adopting these views, the legislature enacted that a board of three commissioners should be appointed by the king, and these should select assistant commissioners, who should receive the authority of the commission by delegation—the commissioners themselves having power to control the entire administration of relief throughout England and Wales, especially the government of workhouses.

The inequality in the populations of parishes, and the inability of many to furnish *any*, much less a succession of officers to carry out the provisions, suggested the idea of unions of parishes. This was further urged in consequence of the inequality of the sums raised for the relief of the poor. It was found that the largest parishes paid the least per head of the population, the smallest, the most, and the intermediate, a sum between the two. Taking England throughout, the hundred largest, with a population of 3,196,064 inhabitants, paid 6*s*. 7*d*. per head; the hundred intermediate parishes, with 19,841 inhabitants, paid 15*s*. per head; and the hundred least parishes, with only 1,708 inhabitants, paid £1 11*s*. 11½*d*. per head!

With the above measures, adopted in the new poor-law, was combined an uniform system of accounts, and the appointment of paid and permanent officers; an alteration of the bastardy-law, by which the onus of the liability to support the illegitimate child is made to rest upon the mother, the same as in the case of a widow and her lawful children; and making it necessary to bring collateral evidence with that of the mother to establish her charge against the person she accuses of being the father.†

With regard to the law of settlement, the principal alterations in it were the repealing the settlement by hiring and service, which, in a manner, bound the labourer to his parish, and created a dependence upon it; the settlement by occupation without payment of poor-rates; and that by apprenticeship to the sea-service. Some alterations were also made in the law of removal of paupers; but these are in some cases evaded with great cruelty, and in others legally enforced, with entire disregard to the justice of the case.

The results of the alterations in the poor-laws are well known, and require no detailed account; but the following statement of pauperism in the twenty unions of Sussex, before, and one year after, the passing of the new act, is worth recording:—

Population	205,936
Average annual rates up to the time of forming the unions	£229,643
Rates for the quarter, June to September, 1836	£27,044
Number of able-bodied paupers at the time of forming the unions	6,160
Number of ditto, March, 1836	544
Number of ditto June, 1836	124

We believe the improvement has been general throughout the country, and that now,

* Report, p. 296.

† "An unmarried girl, upon leaving the workhouse after her fourth confinement, said to the master, 'Well, if I have the good luck to have another child, I shall draw a good sum from the parish, and with what I can earn myself, shall be better off than any married woman in the parish;' and, the master added, she had met with the good luck she hoped for, as

after seventeen years' trial, the country is perfectly satisfied with the change. The moral effect is quite as great as the material and social one. The only part of the act which strikes the humane as unjust and harsh, is the separation of husband and wife, and that of parent and children, when necessity compels them to seek an asylum in the workhouse. To an aged couple, past work, this clause in the act is a species of cruelty which is considered by many wholly unnecessary, however plausible may be the reason adduced for it. To separate those who have passed their days together in harmony and love, and whose only remaining consolation is thus wrested from them,—that of sharing each other's sorrows, which would thereby mitigate them,—might surely be, by some trifling arrangement, avoided without increasing the burthens upon a union, or disturbing the general arrangements under the law.

Tithes.—The origin of tithes is involved in some obscurity, unless we take it from the practice of the patriarch Abram, who paid a tenth of the spoil he had taken from Chedorlaomer, to Melchizedek, King of Salem.* This, however, was not a tenth of his income, or an annual, or periodical payment, and has therefore no affinity to the tithes under the Mosaic law, or to those now paid to our clergy. The case of Jacob also is alleged, in which he vowed to devote to God a tenth of all that He should give him, if He prospered him in his journey. But in this case also, Jacob, who made the vow, was himself, like Abram, a priest; and the vow was not to another priest, but to the Divine Being himself. In both these cases, too, the tenths were free and voluntary gifts—in that of Abram, an isolated act of homage to a superior chief, or king, who was also a priest; and in Jacob, a grateful acknowledgment of the superintendence of God in the disposal of the blessings of life.

The establishment of tithes as a means of support of religion was definite enough in the history of the Israelites under the Jewish dispensation. They were of four kinds:—first, the tithe of all the fruits was given to the Levites; secondly, the tithe, or tenth, of the remaining nine parts was set apart in each family, to be taken to Jerusalem for the service of the tabernacle or the temple; thirdly, the tithe of the tithe was to be given by the Levites to the priests; and, fourthly, tithes of the third year. These were for the support of the Levites, strangers, fatherless, and widows. The whole of these tithes are estimated to amount to one-sixth of the Jew's income.

It is upon the Jewish law, as above stated, that the system of tithes under the Christian dispensation receives its sanction; but if the two cases are closely investigated, they will be found totally different in principle and in detail. The Jewish form of government was theocratic, and the Divine command to the Israelites to pay tithes, was closely allied with the ceremonial observances under the Levitical law. Under that law there was a special object in the establishment of tithes as a part of it, namely, the service of the tabernacle, and it was constantly and necessarily connected with the altar and the sacrifices thereon; and besides, the tithes were not given to the Levites until they had been presented at the altar as "a heave-offering to the Lord," without which they were considered polluted and unsanctified. They were, therefore, a sacrificial offering from first to last; for when the Jewish altar and sacrifice were abolished, the tithes ceased,

she told him, a short time before I was at Holbeach, that she was five months gone with child. I asked what she got for each child? He answered, 'Two shillings; and that women in that neighbourhood could easily earn five shillings a week all the year round.' Thus she will have fifteen shillings a week."—Report, p. 176.

* Gen. xiv. 20.

and the Jews have never resumed the practice of paying tithes. It is not a little remarkable, too, and confirmatory of this view of the case, that for the first three hundred years of the Christian dispensation, tithes were never thought of, or attempted to be re-established; and it was not until the Christian worship began to be corrupted by the introduction of an altar, and oblations, and lighted candles upon it at noon, that the attempt to renew the system of tithes took place.

Another peculiarity of tithes under the Mosaic economy was, that although the Divine command was imperative, there was no civil penalty attached to its non-observance. The contributions, in fact, were voluntary, and only morally and religiously binding upon the Jews. Punishments were certainly threatened to be inflicted upon the Jews for the non-observance of *any* of the Divine commands as given by Moses, and *that* respecting tithes among the rest; but those punishments were divine, not human, inflicted judicially and providentially by Him who was the object of the worship, for the support and maintenance of which the tithes were appointed. This again proves that they were part and parcel of the Jewish ceremonial law, which was abrogated by, and upon, the introduction of Christianity; under which, no intimation is given by its founder of its renewal. On the contrary, it was enjoined upon the apostles to go forth and preach the Gospel without taking any precautions for their own maintenance. In accordance with this, they and their successors in the ministry, for three hundred years, were supported entirely by the voluntary contributions of the body of the believers.

The first intimation in history of the adoption of the system of tithes was in 356, when, at a provincial synod, held at Cullen, they were declared to be "God's rent." It does not, however, appear that tithes were at all introduced into England until the year 794, when Offa, the Danish King of Mercia, gave to the church a legal claim to the tithes of all his kingdom in expiation of the death of Ethelbert, King of the East Angles, whom he had caused to be murdered. It is supposed by some that tithes were collected from the time of the arrival of St. Augustine; but there is no proof of this, and the law of Offa is the first intimation in history of their adoption, and of the church obtaining by law a civil claim to them in England. Sixty years after, Ethelwulph extended the right of the clergy to tithes over the whole of England.

It should, however, be stated, that in 786, that is, eight years previous to the gift of Offa, at a synod, it was decreed that the payment of tithes should be strongly enjoined upon the laity. This was in imitation of Charlemagne, who in 773 had established the system in France. He divided tithes into four parts :—the first, to maintain and repair the edifice; the second, to support the poor; the third, for the bishop; and the fourth, for the parochial clergy. The system was established throughout England by a convention of the estates of the realm, consisting of the kings of Mercia and Northumberland, the bishops, dukes, senators, and people.

Blackstone alleges, as another foundation for the establishment of tithes, the *Fœdus Edwardi et Guthruni*, or the laws agreed upon between King Guthrim the Dane, and Alfred and his son Edward the Elder, successively kings of England, about the year 900.* This arrangement both legalizes the exaction of tithes by the clergy, and imposes a penalty upon non-payment; and this was confirmed by Athelstane in 930.

It is worthy of remark, that the heathen nations exacted tithes for the service of their gods. Thus, Xenophon mentions in his "Expedition of Cyrus," that they found a

* Blackstone's "Commentaries," b. ii. c. 3, sec. 1.

column, on which was an inscription warning the people not to omit offering a tenth of their revenues every year to the goddess Diana, whose temple stood near. The Babylonians, Egyptians, and Romans paid tithes—the two former to their kings, probably for ecclesiastical purposes; and the latter gave a tenth of all they took from their enemies to the god Mars;* and Festus Pomponius† (A.D. 358) states that the ancients used to give tithes of everything to their gods.

Such are the facts in history, upon which the present claim of the church to tithes is founded. Still, the question returns of the adaptation of a system which, in the case of the Israelites, was certainly merely ceremonial, and connected with a ceremonial institution which has wholly passed away, to another institution, the Founder of which repudiated compulsory support, and whose disciples and followers acting upon that repudiation, threw themselves upon the free and voluntary contributions of the church at large for three centuries after His death? Taking, however, the system of tithes as an established fact, as well as a law, of long standing, we shall now state the objections to their exaction *in kind,* which induced the legislature of the country to substitute for it a rent-charge upon the land.

The subject was brought before parliament in the 6th year of William IV. It was previously agitated in Ireland, where, by the advice and assistance of O'Connell, who might at that time be termed the *de facto* "King of the Irish," the people had almost wholly repudiated tithes, and set themselves in defiance of the laws for their collection. So determined and general was this opposition, that the clergy, being reduced to the greatest distress, were anxious for a change; and the government, yielding to a necessity which was above every conservative consideration, introduced and passed a bill for the substitution of a rent-charge upon the land, payable by the landowner, and not by the tenant, who was from that period exempted from a direct tax, which had always been a source of dissatisfaction on account of the hostility of the majority to the established form of religion.

The change effected in the tithe system in Ireland produced a movement in England for a similar measure. In some important respects, it is true, the cases were by no means analogous, the Church of England being, in regard to its doctrines, in conformity with the great body of the people. Even many of those who dissented from its ritual regarded the tithes, by reason of their antiquity, as much the property of the impropriators, whether lay or clerical, as the land was that of the landowners. Notwithstanding this, there were serious objections of a public and national character which, whatever might have been the case in former times, stood in the way of the improvement of the land and prevented its increase in value in proportion with other things. By taking one-tenth of the produce, without deducting anything for the rent, taxes, interest of money, and cultivation of the soil, the tithe, instead of being one-tenth, amounted to nearly (if not quite, in some cases) one-half of the profit of the farmer, and *that* without any of the anxiety or trouble of raising it. It is evident that this must ultimately fall upon the landlord, because, where the tithes were taken *in kind,* they always entered into the calculation in the contract for a farm, and were estimated according to the strictness with which the incumbent exacted his dues.

Nor was their influence less felt in preventing the improvement of the soil. Whatever a tenant might effect in this respect, he was certain that the clergyman would take

* Cæsar's "Commentaries." † "De Verb. Signif."

far more than his equitable share of the benefit. For instance: suppose a person takes a farm, the land of which, in its unimproved condition, will yield twenty-five bushels of wheat per acre; but by draining, subsoiling, extra manuring, and superior management, it is brought to produce, say forty bushels; the tithes upon the latter will be four bushels instead of two and a half, the extra bushel and a half being taken without the receiver of the tithe having participated to the extent of one penny in the expenses the farmer has incurred in rendering the land more productive, and it probably amounts to nearly the profit upon the expenditure by which the increase has been effected; this, too, would continue year after year, as long as the lease continued.

But this is not all the evil arising from the system in preventing improvement. A farmer, in most covenants of lease, is restricted from selling or otherwise parting from any hay or straw raised upon the land, in order to prevent it from being exhausted; and any slight deviation from this almost universal covenant would involve the inevitable forfeiture of the lease, whatever expense he might otherwise have incurred in improving his farm. This is no imaginary case, but one that has repeatedly been the cause of ruin to the tenant who has fallen into the hands of an unscrupulous and unreasonable landlord. Well, here was a system which, without any compensating application to the land in the shape of manure, took equal to *the entire year's produce every tenth year*, of hay, straw, corn, roots, &c. &c., and without paying one shilling towards the expenses by which the several crops had been raised. It is no alleviation of the injury, that instead of being all taken at once every tenth year, it was levied upon the farmer by degrees; the evil was quite as great, and as destructive to the land, though less felt, like all progressive evils. Had the custom been changed to every tenth crop of the entire farm, the monstrosity of the mischief to the land would certainly have been more palpable, but not less certain.

The above evils of the tithe system were so fully and ably urged in parliament, that in the 6th and 7th of William IV. a bill was passed by which the collection of tithes was thenceforth abolished, and a rent-charge substituted. This was denominated "An Act for the Commutation of Tithes in England and Wales," and commissioners were appointed under it to carry out its provisions.

The statute substitutes, in lieu of the right to tithes in kind, an annual money payment, in the nature of a rent-charge upon the land, and payable half-yearly, with power of distress and entry upon the land in default of payment. The commutations are either voluntary or compulsory, being in either case arranged under the superintendence of the tithe commissioners. In the first case, meetings of the landowners and tithe proprietors of every parish were convoked for the purpose of coming to an agreement for the general commutation of the tithes of each parish; and the act declares that a parochial agreement to the payment of an annual sum by way of rent-charge in lieu of great and small tithes respectively or severally to the respective owners thereof—if executed by the land and tithe owners present, whose interest in the land and tithes of the parish respectively shall not be less than two-thirds of the land subject to the tithes, two-thirds of the great tithes and two-thirds of the small tithes—shall, subject to the approval of the patron and of the tithe commissioners, be an effective commutation, and bind all persons interested, as owners of the tithes and of the land in the parish.

In the case of compulsory commutation, authority is given to the commissioners after the 1st of October, 1838, to ascertain and award the value of the tithes in a parish in which no previous commutation has been effected, the value to be computed on an average of tithes for seven years preceding Christmas, 1835, deducting all necessary expenses for the collecting and preparing for market or sale (where the tithes were taken in kind), but making no deduction on account of parliamentary, county, parochial, or other rates and assessments to which tithes have been liable. Power is reserved to the commissioners, in certain cases, to diminish or increase the sum to be paid for commutation. Special provisions are made for valuing the tithes of hops, fruit, and garden produce, for the valuation of lands to which a seven years' average will not apply, and for allowing for moduses, compositions, real, or customary, or prescriptive payments in lieu of tithes, in the award. The commissioners are to hear and determine disputes touching the right to tithes and the existence of moduses, &c., and claims of exemption from, and non-liability to, the payment of tithes; subject, however, to an appeal by an issue at law, or, as the case may be, to the opinion of a court of law. The terms of the award to which the commissioners have agreed, having been made publicly known, and they having heard and considered all objections that have been raised thereto, shall finally confirm the award; and then valuers, chosen by the owners of land subject to tithes, shall proceed to apportion among the said owners the sum awarded. The amount of rent-charge is to be regulated by the corn averages, and land may be given by the landowners in lieu of the said rent-charge. By the 5th of Victoria, c. 15, it is enacted that lands shall be discharged from tithes after the confirmation of the award, and previous to the confirmation of the appointment, where security is given by the landowner for the due payment of the rent-charge. The rent-charge is subject to all rates, &c., to which tithes had previously been liable; and these, by the 1st of Victoria, c. 69, are to be assessed on the owner of the rent-charge.

Such are the main provisions of the bill, which reflects as much credit on the parliament as it did on those who first originated it. Not only was the tithe system a continual source of ill-will and bad feeling between many of the clergy and their parishioners, but in many cases the means of annoyance resorted to by both parties when disputes arose, were of the most disgraceful character. As a farmer could not remove his own corn until the parson had set out the tithe, the latter has in some cases been known, by way of revenge, to let corn remain until it was destroyed by the weather. On the other hand, farmers have given notice to the clergyman of their intention to take up turnips or other roots on a certain day, and when the latter has sent his horse and cart, the farmers would draw ten turnips and tell the tithing-man to take *one*, "but it would not suit them to draw any more that day." *

The injury done to religion itself by such bickerings as these was incalculable. What possible harmony could exist in a parish, or what moral influence could a clergyman possess, where such a spirit was displayed on either or both sides? The interests, therefore, of the Establishment itself were as much concerned in procuring the change as those of the landlord and tenant; and all parties must rejoice that a source of so much evil, moral, spiritual, and material, has been abolished. In almost all cases the collection of the tithes in kind excited a hostile feeling against the clergyman, because the very act proved he was determined to claim his rights to the very last farthing, especially when the small tithes, such as eggs, fowls, milk, pigs, vegetables, and other garden produce were collected, which was commonly the case, to the disgrace of the clergyman and the intolerable annoyance of the farmers. There is no doubt that at the time when tithes

* Report.

were introduced into England, they, as well as rents, were paid in kind on account of the scarcity of money. Almost all trade also was at that period carried on by barter; and the low price of land and of every kind of agricultural produce made it an easy matter to pay a tenth of the latter to the clergy. Even so late as Latimer's time (the beginning of the sixteenth century), which was just after the discovery of America, the rent of land was exceedingly low. "My father," says that great reformer, "was a yeoman, and had no land of his own; only he had a farm of three or four pounds by the year at the uttermost, and hereupon he tilled as much as kept half a dozen men. He had walk for 100 sheep, and my mother milked thirty kine. He was able to, and did, find the king a harness, with himself and his horse, while (until) he came to the place that he should receive the king's wages. He kept me to school, else I had not been able to preach before the king's majesty now. He married my sisters with five pounds, or twenty nobles apiece, so that he brought them up in godliness and fear of God. He kept hospitality for his poor neighbours, and some alms he gave to the poor, and all this he did out of the said farm." When we compare the abundance of the produce as implied in the above statement, which supported six men, and enabled his mother to keep thirty cows, &c. &c., with the small amount of money by which the rent and his daughters' fortunes were represented, we may readily conclude that it was far more easy, up to that period, to pay tithes in kind than in money. That the practice should have been continued after money had become more plentiful, and especially after the Reformation, can only be accounted for by the greater difficulty of effecting changes in ecclesiastical than in civil matters, and to the clergyman preferring the practice to that of being paid in money—because in one case he was certain of having *all* that the law gave him, whilst in the other a fixed sum only was paid, which might, or might not represent his legal claim. The entire change in the social condition of the country had long rendered the practice, not merely inconvenient and annoying to the farmer, but unjust and disgraceful to the clergy. Such was the view taken by the legislature when the subject came before it for discussion; and the result has proved the change to be in accordance with the principles of reason and equity.

SECTION VIII.

THE GAME LAWS.

Perhaps there is nothing in the management of landed property more destructive to good husbandry, or more obstructive of agricultural improvement than the game laws, as they are now administered by the magistrates in many parts of the country, and the excessive preservation of game on many of the large estates of the nobility. The length to which this latter practice is now carried, and the stringency with which the occupiers of land are debarred from destroying the game which they have fed, or from in any way keeping down the breed of hares and rabbits, argues as little for their honesty, as it does for the good sense of the landowners. Perhaps, however, the farmers themselves, after all, are to blame; for if they would as a body set their faces against the system, and one and all refuse a farm on which the game is strictly preserved,—and which are generally known,—the landowners would soon be compelled to make a change, and bring the system more in accordance with the spirit of the age.

The "privileges of the chase" are of very ancient standing, having existed from a period long previous to the Norman Conquest. Before the reign of Canute it was almost exclusively a royal prerogative to kill game of any kind, not even the allodial proprietors being allowed to do so, except by hawking. That monarch was the first to extend to the yeoman the right of hunting and shooting with the cross-bow, as well as hawking, on their own land, but not on any royal manor, forest, or chase.* By the 13th Richard II., stat. 1., ch. 13, a property qualification was instituted, and persons not having to the value of 40*s.* a-year in land, if a layman, or a benefice of £10 a-year if a priest, were not allowed to keep greyhounds, or use ferrets, or to take hares, rabbits, or other gentlemen's game. This qualification was increased from time to time, until by the act of the 22nd and 23rd Charles II., ch. 25, sect. 3, it was raised to £100 a-year in lands, tenements, &c., or £300 a-year in personal property. This continued the law until 1831, when the property qualification was abolished altogether, and any person taking out a licence was qualified to shoot on any land with the consent of the owner.

The game laws are a relic of the feudal system, and are held by the landowners with so much tenacity, that while they can command a majority in parliament it will be the last that they will give up; yet they have been denounced by some of our first lawyers as unworthy of the English constitution and code. Blackstone says, "Though the forest laws are now mitigated, and by degrees grown obsolete, yet from this root has sprung up a bastard slip, known by the name of the game laws, now arrived to, and wantoning in, its greatest vigour; both founded upon the same unreasonable notion of a permanent property in wild creatures, and both productive of the same tyranny to the commons, but with this difference, that the forest laws established only one mighty hunter throughout the land, the game laws have raised a little Nimrod in every manor. And in one respect the ancient law was less unreasonable than the modern, for the king's grantee of a chase or free warren might kill game on every part of his franchise; but now, though a freeholder of a £100 a-year is forbidden to kill a partridge on his own estate, yet nobody else (not even the lord of the manor, unless he has a grant of free warren) can do it, without committing a trespass and subjecting himself to action."†

The forest laws were severe enough before the Norman conquest, but much more so after it. In creating the New Forest in Hampshire, William destroyed the country, and drove out the inhabitants of forty-five square miles (12,271 acres). Hollinshed says that all the county of Essex was once a forest. The four principal forests at present are the New Forest, Sherwood, Dene, and Windsor.

The game laws are almost the only remaining statutory features of feudalism in England, and are in their nature perfectly *sui generis*, there being nothing at all similar

* In Coke's "Institutes" it is stated that "the forest and chase differ in officers and laws. Every forest is a chase, but every chase is not a forest. Both differ from a park in not being enclosed, which the park must be, as its name implies, being derived from the French verb *parquer*, 'to pen up or inclose.'" It is called in Doomsday *parcus*. In law it signifies a great quantity of ground inclosed, privileged for wild beasts of chase by prescription, or by the king's grant. The beasts of park or chase properly extend to the buck, the doe, the fox, the matron, the roe, but in a common and legal sense to all beasts of the forest.—"Institutes," lib. iii. cap. 5, p. 233, sect. 378.

† Blackstone's "Commentaries," bk. iv., ch. 33.

to them in nature in the whole of our social system. The laws that protect property, whether real or personal, do not apply, and have no analogy with those for the preservation of game. There is not, and there cannot virtually be, a property in a hare or a pheasant at large similar to that in a sheep, a bullock, or a horse. A landowner may certainly raise a head of pheasants or other game in his preserves, and by dint of feeding them constantly may prevail upon them to remain, or make that spot their home; but unless he likewise incloses his preserve in an immense aviary he cannot prevent them from flying off to his neighbour's plantations, where they are no longer his, and may be killed by the said neighbour. With all his care and feeding they are wild animals still, and the property of any person to whose ground they choose to resort. He can neither claim them dead or alive, nor prosecute any one for killing them except as a poacher. It would be impossible to make a property of game otherwise than by confining them as we do rare foreign birds in aviaries. Even Colonel Hawker, who is a great stickler for proper game laws, confesses that, much as it would be to his private interest to make them property, he could not "conscientiously say that it would give satisfaction to the public. The most correct man," he says, "would for ever be liable to get into difficulties, by which means there would be more, instead of fewer, disputes between sportsmen and occupiers of land."*

We have stated that the Game Act of 1831 allows the farmer, with the consent of the landlord, to kill hares and rabbits in any way without a licence; and this was confirmed by the act of 1860, when the new regulations respecting the game licences were enacted. These animals are considered by all except the inveterate game preservers, as vermin, and as such they ought to be destroyed by the farmer. But the statute, however intentionally favourable to the occupier of land, is rendered nugatory by leaving it to the decision of the landlord, whether the tenant may or may not destroy these pests. This is a heavy grievance, because in a large majority of cases, the landlord will not allow the tenant to kill hares, whatever he may do in regard to rabbits. In other words, they who feed the game, and in some cases are eaten up by it, are prohibited from shooting or trapping as much as the stranger. "Following up the same bad policy, the landlords make war with the very men who, of all others, have the power to be our best assistants, who are constantly on the ground, and about it at all hours, and who have the lower classes under their immediate control—I mean the farmers. They who feed the game are subject to even a greater penalty than the unknown trespasser, and are liable to pay £1 for every head of game, in addition to the £2 penalty for trespassing. Can any man of common sense imagine that while such a law exists a farmer will exert himself to prohibit his labourers from poaching, or feel the smallest interest in preserving the nest of a partridge? Impossible!"†

With respect to the description of animals denominated "game," it has varied at

* Hawker on Shooting, p. 497. An amusing incident illustrative of the folly of calling game property is given in an admirable paper read before the Farmers' Club by the secretary, Mr. Corbet, and afterwards published as a pamphlet by Ridgway. "A Sussex gentleman I met the other day, not a heavy game preserver, but who has a little quiet shooting of his own, gave me the following anecdote. During the past season he killed a few fine fat pheasants, to which his cook called his attention as all remarkable for having *no back claw*. He could not explain this at the time; but, meeting the head keeper of a neighbouring establishment a few days after, he began to tell him the story as rather a curious fact in natural history. He got no further, however, than 'they were in famous condition, and had no *back claws*,' when the other savagely interrupted him with 'Why, dang it! that was our toe-mark; you've been eating *my* pheasants,' as no doubt he had."—Corbet's Tract, p. 10.

† Hawker, p. 493.

different periods. Under the old forest laws it included almost every bird that flies, and every animal that runs. In Coke's "Institutes" they are accurately defined. "There be both beasts and fowles of the warren. Beasts, as hares, conies, and roes, called in records *caprioli*. Fowles of two sorts, viz., *terrestres* and *aquatiles*. Terrestres of two sorts, *sylvestres* and *campestres*: campestres, as partridge, quail, raile, &c.; sylvestres, as pheasants, woodcocke, &c.; *aquatiles*, as mallard, herne (heron), &c. . . . . It is resolved by the justices and the king's council that *caprioli id est non sunt bestiæ de foresta eo quod fugans, alias ferus*. Beasts of forest be properly hart, hinde, buck, hare, boare, wolfe, but legally *all wild* beasts of venery."*

By the act of the 2nd James I., ch. 27, the term "game" included by enumeration pheasant, partridge, pigeon, hearne, mallard, duck, teal, widgeon, grouse, heath-cock, moor-game, and hare. The water-fowl in this list ceased at a subsequent period to be considered game; but, on the other hand, early in the present century, snipes, woodcocks, and rabbits were added to the prohibited list, and they still continue to be absurdly called game, although the two first are to a great extent birds of passage, and at best of that migratory character as to render them even less available as property than pheasants and partridges. The framers of the law could only have included them for the express purpose of preventing unqualified and unlicenced persons from carrying a gun. By the act of the 2nd William IV., the occupier of land is allowed (as we have already stated) to kill hares and rabbits with other vermin, without a licence, with the consent of the landlord, which is so frequently withheld, that the legal permission is rendered in a majority of cases nugatory.

We shall now point out the various objections that are urged against the present state of the game question, and the evils inflicted upon society by the laws. Some of these evils are of such magnitude that a few of our nobility have on account of them nobly abandoned the system of game preserving. If more have not done so it is because of the selfishness of the advocates of the system, and their desire to withhold from their dependents a privilege they wish to monopolise to themselves. In enumerating these evils we would defend ourselves from the supposition that we consider a due protection of game by law an evil, or that it should be lawful for any one to destroy it without restriction. We believe that if a liberal and honest law were enacted, allowing those who feed the game to kill it for their own use, it would meet the approval of the great body of tenant farmers, and that there would be no lack of game on the farms when the occupiers were thus endowed by law with an interest in its preservation. The old-fashioned field-sporting and wood-shooting with dog and gun is conducive to health, imparts a manly vigour and bearing to the character, and affords an agreeable variety in the monotony of country life. On the other hand, there would be no justice in allowing any one *by law*, and without leave from the owner or occupier of land, to run over an estate or a farm for the purpose of killing game, to the rearing of which he has not in any way whatever contributed. This restriction, however, is not intended to apply to those birds of passage and aquatic fowls which come and go, having no settled abode on our shores. These cannot by possibility be anybody's property, or form an exclusive privilege of killing them, and should, therefore, be left free to whoever may consider it worth his attention to pursue them. To abolish entirely the game laws, and allow every one to range the country for the purpose of killing game without reference to the owner or

* "Institutes," lib. iii., cap. 5, sect. 378.

occupier of a farm, would be productive of as much evil as the present system. The appropriation of the land renders it unbearable, if not impossible, that it should be liable at all times to be overrun by any one who can purchase a gun or keep a dog. The interests of agriculture, and, therefore, of the country at large, require that trespasses on private property should not be allowed on any pretence whatever, and that the game should belong—not as *property*, but as of privilege—to the owner or occupier of land, as they can agree between them. It is, therefore, against the excessive preservation of game, and the restriction laid upon the farmer who feeds it, that the observations are directed, and from which all the accompanying evils originate.

These are comprehended in—first, the injury sustained by the farmer and the nation at large in the destruction of crops; secondly, the encouragement given to poachers; thirdly, the employment of gangs of keepers; fourthly, the demoralization of the lower classes; fifthly, the lowering of the character of the landowners.

First,—the injury done to the crops of grain and roots is incalculable; but it may be said to be so great as to form no small national consideration, and would probably amount (it it could be estimated) to thrice the value annually of all the game in the country. The late Mr. Pusey estimated that three hares will consume as much as a sheep; but even this does not half represent the injury done to a crop by these vermin. A hare is a very dainty animal, and in entering a turnip field in a morning, hungry, will chip off the rind of perhaps half-a-dozen turnips before he makes his selection for a breakfast. Every one of these chipped bulbs is by that act exposed to the action of frost and rain alternately, and if it has done growing will infallibly be rotten as soon as the frost goes away. It may easily be conceived what will be the effect upon fields bordered by coverts in which are kept from 200 to 500 hares, all of which are at full liberty, without molestation, to gratify their *tastes* as well as their appetites. The injury to the grain crops may not be so palpable to the eye as that to the turnips, but it probably amounts to far more in value. "Look at the progress," says a practical farmer and land agent (Mr. Grey, of Dilston), "of a single hare. You see a hare enter a wheat-field; you see him pick out a stem here and there in his course over the field; he will nibble an inch or two from this stem, and he does not stop till he has cut off a great many. It is not that the inch he has consumed has any appreciable value whatever, but the ear of corn would have been matured, which the hare has prevented by cutting the stem off; and if you consider the damage which is done by one individual hare in a wheat-field in one night, you will find that the damage done by these animals night after night comes to a considerable sum: it may amount to bushels an acre."*

Another case is mentioned by Mr. Corbet. "My correspondent," he says, "is an extensive occupier in one of the best farmed counties in England, but farther than this I shall not care to identify him. I shall allude to hares in the first instance, considering them to be the most objectionable: they are in the habit of congregating together, and may be seen as many as one, two, and three hundred, or more, in fields of from twenty to forty acres, feeding on the produce of the land; and I need scarcely say they prefer the best and sweetest herbage. Game abounds chiefly on light soils, and dry seasons greatly favour their destructive habits. The cereals being of kinder growth and naturally of sweeter quality, it is here that irreparable injury is done to growing crops, be they wheat, barley, or clover,—constantly eating day and night, and all the

* Corbet's Tract, p. 12.

year round, does it not become evident they must consume and destroy what would and should have been additional food for man and beast? But hares are most destructive to crops in the months of May and June: always on the move, they cut their way through the corn and clovers; and to such serious extent do they clear off roods, and in some instances acres together, that, literally, I have smelt the perfume arising from the withering influence of hot weather in those months. Independently of the loss just mentioned, which appears, as it were, sheer mischief, the corn thus prematurely cut off will attempt to grow again, and, if some of it should be so fortunate as to get partially into ear, will always be so far behind the other portion of the field at harvest as to greatly injure the sample of produce already diminished in yield. It may be considered a pretty novel sight to see two or three hundred hares in an enclosure as we travel through the country, just as we view a herd of deer; but does it strike the beholder they are eating the farmer's produce? Is it just, I ask, that land capable of providing food for the country should be allowed, I may say, to be monopolised by game?"

Rabbits, it may be said, are individually less injurious than hares; not being of so roving a disposition they keep nearer to their burrows. But, on the other hand, in their localities they destroy everything; and in consequence of their breeding so frequently,—every month or six weeks, throughout the summer,—and having so many at a litter; when they are preserved, which they too frequently are now, as the perquisite of the keeper, or even as a part of his salary, they very soon overrun a farm, and lay waste every crop. Both these and hares ought to be considered by the legislature as much vermin as rats and hedgehogs, for they are far more deadly enemies to good husbandry than either of the two latter. At Southacre, in Norfolk, according to the testimony of one of the most eminent farmers in the neighbourhood, who calls it the "plague spot of the district," it is no uncommon thing for the party there to shoot four hundred or five hundred hares in a day when they shoot those coverts. And as to rabbits, they are sent to Sheffield by half-ton and ton at a time. "But if a fox goes to Southacre he gets his toes nipped. . . . . . The place swarms with vermin—rats, rabbits, and hares." The writer, who is a landowner as well as a farmer, adds, "Preservation to the game—pheasants and partridges; but destruction to the vermin—rats, rabbits, and hares!"

Such is the case with the preservation of hares and rabbits; pheasants and partridges are generally considered as harmless compared with them; yet the excessive preservation of pheasants is kept up at no small cost to the farmer, notwithstanding they are regularly fed by the keepers. At seed time, it is almost in vain to sow wheat in the vicinity of a covert where there is a large head of these birds, for they are sure to scratch up and eat enough to spoil the crop. And the case is still worse when the corn is ripe and on the shock. Here again we must refer to Mr. Corbet's paper for the following graphic description:—"Occasionally they do a great deal of harm and eat a vast deal of corn. No one who has seen them perched on the shocks, towards the end of harvest, can suppose their investigations, at such a time and place, are directed altogether to the extermination of the wire-worm. And I am assured that during the last season, on the property of a noted game-preserving nobleman in Suffolk, towards the close of an autumn afternoon, three hundred pheasants were counted round a tenant's barley stack. I will not say exactly what they were there for. It might, perhaps, be a public meeting, called by some old cock, to take into consideration what effect the chancellor of the exchequer's proposition for a cheap certificate might have on the long-tailed interest; or to devise some measures against the coming discussion at the Farmers' Club. However, as it is a pretty general rule with us to wind up all such proceedings with a dinner, I much question whether this influential gathering separated without partaking of some refreshment. The pheasants shall call the meeting, the marquis shall give the land to hold it on, and Mr. Martyr shall stand the dinner. But these birds do not confine themselves to corn. At a recent valuation on the western line, for damages done by game, a shepherd declared that, 'in the spring of the year, he believed the pheasants ate as much of the Swedes as his flock of sheep.'"*

Secondly,—the encouragement given to the poacher by the excessive preservation of game, is in itself an evil that calls loudly upon the legislature to interfere. It is not denied that, whether game is preserved in large or small numbers, there will still be reckless men who will risk the penalty they incur, for the sake of the exciting pleasure of the lawless pursuit. In fact, it is exceedingly difficult to persuade a peasant that the destruction of wild animals,—as they justly consider them, for they are denominated *feræ naturæ* by lawyers,—is any crime. It is hard to convince them that the crime consists, not in the killing of the pheasant or hare, but *in the breach of a law*, the observance of which involves no moral sacrifice of principle, and which, being passed by the representatives of the nation, ought to be obeyed while it exists. Besides, the breach of any law habitually, whether human or divine, weakens the moral principle, and prepares a man for the perpetration of other offences without compunction. We thus find that there are very few confirmed poachers who would hesitate to rob a hen-roost, or even take a sheep, if their necessities drive them to an extremity. Poaching, therefore, prepares a man for the commission of any crime—too often even that of murder—rather than be taken.

But, if poaching would still exist if game was less strictly preserved, the inducement is increased tenfold when pheasants are reckoned by hundreds and even thousands in the coverts of the nobility and gentry. "Where the carcase is there will the eagles be gathered together." A heavy preserve of game is sure to create a corresponding number of poachers in the neighbourhood; and a large staff of gamekeepers will always be met by as numerous a gang of their sworn enemies. The consequence is, that when these two parties meet, there is a sort of chivalry in the combat that ensues, which ends frequently in murder, on one side or the other;—for we scruple not to say, that to take the life of a man for the crime of killing a pheasant, is neither more nor less than legal murder; and whatever the law may do to exonerate the keeper, the Divine law is above it, and to that the perpetrator will eventually be amenable. It is the *game-preserver* who is the real murderer, by indulging a selfish passion to that excess as to keep up a staff of men for the protection of his pheasants and hares, at the expense of human life, if it cannot be done without. What generally renders these combats between poachers and keepers so deadly, is that the latter are frequently, if not generally, chosen from amongst the most daring and intelligent of the former, on account of their intimate acquaintance with the neighbourhood in general, and of the poaching fraternity in particular. The poacher, therefore, aware that he is known, and can be recognised after the affray, becomes reckless and desperate, and makes no scruple of taking the life of his deadly enemy; while, on the other hand, the keepers themselves are by no means backward to pay the poacher in his own coin; and thus it becomes a life and death struggle, for the sake of preserving a

* Corbet's Tract, p. 20.

wild animal which virtually can never be made property except it is caged, but which belongs to any one upon whose grounds it is found.

Colonel Hawker, who so "conscientiously" declared that he could not say that game could be made a property, illustrated this difficulty in his advice to a young sportsman:— "It often happens," he says, "that the boundaries of a liberty end with a broad hedge-row, which may be *too high to shoot in,* and may have land on the *other side, belonging to some one who is not on terms with the owner,* and towards whose property all his game fly out on the *wrong side* of this little covert. He has then only to sow *buckwheat* and *sunflower-seeds,* and plant *Jerusalem artichokes,* for the *pheasants,* and *Swedish turnips, Dutch clover,* or *parsley,* for the *hares,* on his own side, and cut down a space *broad enough to shoot,* on the *enemy's side, in the hedge-row,* which will soon induce him to compromise on equitable terms. Because, should his competitor even do the same, he will most probably still have his share; and if not, he will get away a great part of his game."* Are we to hear about "my game" after such a systematic method of decoying it as this?

But do not the landed proprietors themselves encourage poaching, by systematically purchasing pheasants' eggs, and even pheasants, of the poacher? Mr. Corbet says on this head, "The very game preservers and keepers are known to directly encourage them. For are they not amongst the best of customers for eggs and birds? inciting, *in that selfish spirit so thoroughly identified* with the whole business, a clever hand at it to rob any neighbouring manor in order to stock his own. Cash on delivery, and no questions asked." He adds, in a note, "We have seen magistrates the receivers of stolen goods—egg buyers; gentlemen the intimate companions of keepers and watchers; tenants with characters traduced, crops consumed, and no redress; and labourers seduced to evil by the high premium placed upon success in crime, viz., 'Pheasants' eggs bought here at 12*s.* per dozen!'"—(B. in *Mark Lane Express,* of March 10, 1860.)†

With such temptations and such examples before them, is it any wonder that an ignorant peasant should look upon poaching as no offence against a just law, and that it is the selfishness of the landowner that alone makes it a crime to kill a head of game? But the most extraordinary part of the case is, that these very magistrates, if a poacher is brought before them, will display the most vindictive and relentless disposition; sentencing them to longer or shorter terms of imprisonment with all the eagerness of the most virtuous dispenser of the law. Nor is it the least unfortunate circumstance in this matter that clergymen of the Established Church frequently preside at the petty sessions on these occasions, and display as great eagerness in the conviction and punishment of poachers as the most strenuous upholder of feudalism. Let these clerical magistrates reflect upon the mission of mercy to which they have nominally given themselves, and then consider how incompatible with that mission is their conduct in thus sitting in judgment upon their neighbours and, probably, parishioners in such cases; and what must be the effect, in neutralizing their exhortations from the pulpit

* Hawker, on Shooting; the italics are the colonel's.

† The writer knew the case of a magistrate, in Norfolk, who, wishing to stock a new covert, went to a noted house of call for poachers at Norwich, and inquired of the ostler or the master whether he could procure him thirty head of live hen pheasants? He was requested to call the next week, when a reply would be ready for him. Accordingly, on the following Saturday, he went again, when the party told him "he could have them any day he liked, and out of any gentleman's covert in the county;" jocosely adding, "out of one of your own, general, if you please." "No, no, d— them," replied the general: "from anywhere but there!"

on the Sunday, by thus assisting in the dispensation of a law, of which the practice of many of their colleagues on the bench is an open defiance.

Thirdly,—the employment of gamekeepers. This is a necessary consequence of an excessive preservation of game; but nothing can be more destructive to the welfare of an estate than to have a set of these spies constantly prowling about, authorised intruders at all times and places on the farms, and looking upon the occupiers of land as their natural enemies, because they know that their own business is to see that the destroyers of the farmer's profits are not themselves destroyed or molested. These pests of the farmer usually curry favour with their employers by reporting every action of his which *they* consider injurious to the game, or even suspect of being so. "One loathes the very name of such an office," says Mr. Corbet. "You must all know the authority he exercises—a power so much above his proper position in life, and that, as a rule, he proportionately abuses it. To him, the commonest act of husbandry is one of suspicion and distrust. He unites the invincible curiosity of our English Paul Pry with the malicious intent of a spy of the Inquisition. The farmer and his men are continually under his supervision. There is nothing they can do but it is his 'duty,' to overlook them. He stands by the mowers to see they do no harm to *his* nests. He struts into the reaping field to make sure they do not hurt *his* birds. The boy with his scare-crow, the shepherd with his dog, and the little lass with her kitten, are all alike the objects of his hatred and his tyranny. He has been known to wrench a gun from the hand of a farmer's son for shooting a rat! He has told the farmer himself he should prefer his not firing at the birds on the corn, as it was 'such a trouble to be always coming to see what he was after.' He has informed against a tenant, whom of course he was watching, when his victim got off and picked up a hare which his horse had killed in her form; and a bench of magistrates at Newark positively followed this up by a conviction! To the disgust, however, of these Solons, the Commissioners of Taxes promptly reversed the decision. He lays traps for the labourers, as has been proved over and over again, and rejoices, like another Jonathan Wild, or some other such scoundrel, only in the downfall of his fellow-men. He is the very essence of evil doing. He whispers away characters in the ear of his employer; he swears them away in open court. He is incessantly making ill-blood between man and man; and he is the one great blot on our fair English landscape. I have the experience of an old keeper himself to say that such men are rarely to be believed or trusted.* The rabbits are the keeper's perquisite; that is to say, the vermin which do the farmer the greatest injury are the animals above all others that the keeper has a direct interest in maintaining a stock of. The vermin which the law declares the tenant has a right to destroy as vermin, the landlord transfers as a right to his servant. We still hear of head-keepers clearing their £200 or £300

* The following case came under the author's own notice. A relative, who occupies a farm of 700 acres in Norfolk, was allowed by his landlord to shoot rabbits. His farm is bounded on one side by the coverts of his landlord, and adjoining them are those of a neighbouring landowner. This latter paid his keeper in part in money, and in part with the rabbits, which of course it was his interest to preserve as much as possible. Our friend's rabbit-shooting was therefore a constant source of annoyance, and he determined to put a stop to it. He shot a hare himself, flung it into his opponent's field, and then went and told his employer that he saw the farmer shoot and leave it, "he supposed because he saw him near." The gentleman went with him to the field, found the hare, and without calling for an explanation from the farmer, wrote to his landlord, complaining that Mr. —— was shooting his game. The consequence was a peremptory order to the farmer, that he would not in future allow him to shoot rabbits. Some time after, the keeper himself was detected in some malpractices and dismissed, and then the under-keepers told their master the whole affair. The latter, however, had not the honesty to explain the matter to the landlord.

a year by the rabbits; so much gain to them being, as a rule, so much loss to the farmer."*

It is impossible to place the matter in a stronger or more truthful light. The writer has known many keepers, but never known an honest man amongst them, they being, as a rule, selected rather for their daring and physical strength than for their respectability of character. Their vocation is of a piece with that of a common informer, and is estimated accordingly.

Fourthly,—the demoralization of the lower classes, by the over preservation of game and the operation of the game laws, has already been adverted to; and to prove it, we have only to look at the statistics of crime in the blue books, the number of convictions at quarter sessions, and the enormous sums expended in the prosecution of poachers, the bulk of which the farmers themselves have to pay in the shape of county rates; so that they are robbed in every possible way. In 1843 there were, in England alone, 4,270 convictions. This was an exceptional and heavy year, for in 1859 the entire number throughout the United Kingdom was only 2,608. The expense attending the prosecution of these men was enormous. Thus the farmer is called upon, first to feed the game at his own expense; next, to pay the cost of the prosecutions for poaching; and, lastly, to support the families of the poachers during the time they are undergoing their sentences of imprisonment! Can any system be devised more destructive of the best interests of the country than that of game preserving under the present laws, or that is more damaging to the moral character of the rural peasantry? "Poaching," says Mr. Corbet, "is an insidious disease, and I have little doubt but that it reduces a man from bad to worse. Habitual idleness, a passion for drink, hen-roost robbing, sheep-stealing, and even graver crimes, have been the not unusual close of a poacher's career. The over-preservation of game injures the farmer quite as directly in this wise: it demoralizes his labourers, tempts the best away from him, and renders them dissatisfied with, and independent of, a fair week's wages, when they can get £3 or £4 a night in the woods. . . . We have little surplus agricultural labour now-a-days; every man in a parish can be employed to a vast deal more advantage than as a watcher or beater. . . . One of the points of modern husbandry is the use of more labour, and we shall soon want all we can obtain."†

Attempts are making by many of our philanthropists to raise the moral character of the rural population by education and the dissemination of books of a moral and religious tendency. The greatest obstruction to the success of their plans are the beer-shops and the game laws. The first, it is true, is the monster evil, from which almost all crime springs, and at which all the offences against society are concocted. It is here that the old poachers congregate to lay their plans and fix their places of rendezvous, and it is here that the young peasant is entrapped into the gang, and initiated into all the secrets of the desperate profession of a poacher. What chance has the friend of the peasant of making any beneficial impression on him, with such drawbacks as the beer-shop and the public house and their influence to contend with? What hope is there of effecting a moral change in a class who are daily beset with temptations that appeal to their most assailable weaknesses? The vice of drinking, encouraged as it is by the legislature, because of the large amount it brings to the revenue, prepares the peasant for the breach of the law; and the old poacher well knows that if he cannot prevail on a young man to drown his

* Corbet's Tract, p. 17.

† Ibid. p. 25.

sense in liquor, he cannot, as a rule, induce him to risk his safety in the dangerous occupation. He therefore entices him to the beer-shop, where he gradually loses all sense of morality, and all compunctions of conscience, and becomes an easy prey. Against such influences the voice of reason and the efforts of benevolence prove but feeble auxiliaries to preserve the young from their contaminating enticements; and until an entire change is made in the system of licences as well as in that of game preserving, we can scarcely hope to see any great and general improvement in the moral character of the rural population.

Fifthly,—the lowering of the character of the landowners. This is not one of the smallest evils that has arisen out of, or been aggravated by, the excessive preservation of game. There was a time when the "old English gentleman" was the model of everything that was noble, generous, and unselfish—the representative of a class, high-minded, and above petty meanness or mercenary motives in their habits, whether of business or pleasure; treating their tenants and dependents with kindness and consideration; and spurning everything that could compromise their respectability or bring their characters in question as actuated by pecuniary motives in the pursuit of their favourite sport—the chace. In this occupation, the "dog and gun" were the only agents by which the game was found and killed; and the healthful exercise of following the dogs, whether on foot or on horseback, added to the excitement natural to the pursuit, was an ample reward for the expense he might have incurred in raising a moderate head of game. The produce of the day's sport supplied his own table, and if any remained over, it was despatched, "with the squire's," or "my lord's, compliments," to such of his friends or dependents as had no other means of procuring game.

How stands the case now that the *battue* has been introduced, rendering necessary the raising and preserving immense heads of game, and a corresponding number of keepers to protect them from the poachers? This absurd and butcherly *sport*, as it is called, was brought from Germany with many other customs. That country is in great part covered with forests, which abound with game of all kinds, some of which are of the larger kind, as wild boars, bears, wolves, &c. It is evident that in such fastnesses as those, inhabited by these animals, it is no child's-play to pursue the sport of hunting *à l'outrance*. It is, therefore, the custom when a nobleman and his friends wish for a day's, or week's, sport in wood shooting, to summon his dependents by hundreds, who surround the wood, or a portion of it, and by continually drawing towards one common centre, drive the game before them to the spot where their chief and his friends are stationed. Even upon this plan the danger is imminent; for frequently when these wild beasts find themselves thus brought face to face with their foes, they become desperate, and attack man or horse, or both, with the greatest fury; and not unfrequently serious accidents and loss of life occur in the encounter. At the same time a vast amount of courage and prowess is displayed, and large numbers of the terrible game are killed. Each day's sport is wound up with a feast. This is the genuine *battue*, of which the present English *battue* is but a sorry imitation.

What possible analogy there can be between these two practices—except that in both cases the keepers beat the woods—it is impossible to conceive. Nothing can be imagined more insipid or puerile than standing on the edge of a plantation while a gang of keepers drive a flock of half-tame pheasants or hares towards you, in killing which you have no further exercise than taking the guns from the man who charges them for you, and blazing away as fast as the game appears. The sport would be quite as good to stand in the farm-yard and shoot the cocks and hens as they descended from the roost in the morning, or were driven to a corner of the yard for the purpose. They certainly kill large quantities of game in this way, and make a great boast of it in the newspapers. "But let us ascertain the character of the *battue* in the eyes of the great body of Englishmen. What do nine hundred and ninety-nine men out of a thousand think, when they read the *Morning Post* paragraph of what the Earl of Wholesale and Retail, and three or four 'great guns,' did the day before yesterday, at his lordship's magnificent seat, 'the Slaughter-house,' when in the course of the morning they killed some 200 head of pheasants, 150 hares, 300 rabbits, 2 woodcocks and a water-hen, besides seriously wounding a Jack snipe, as well as an under keeper, and half ruining a tenant farmer? With what kind of feeling is it that we regard such terrible sportsmen who thus blazon forth their wondrous achievements? Is it with respect?—with a certain pride in the prowess and manhood of our English gentlemen?—or rather with something like disgust, and an inclination to ridicule the whole proceeding? Have they any of the true attributes of sportsmen—the excitement of finding and following the game, the pleasing recollection of how steadily old Dido hunted up to her birds, or how old Brush stood to the winged pheasant in the hedgerow? Is there the long bracing heat, the healthful fatigue, and the well-won rest that so gratefully crowns the day's sport?"*

This practice is lowering enough, but is followed up by one still more degrading,—that of selling the game to the London poulterers, which is now the universal practice after a *battue*. What indeed can a man do with a thousand head of dead game all on hand at once, but dispose of them in this way? But is this compatible with the high-minded character the English gentleman ought to sustain? Is it not rather reducing himself to the level of the poulterer to whom he sells the game? "The squires," said an eminent agriculturist at a public dinner two years since, "are fast degenerating into poulterers. Things are very different now from what they were fifty years ago. Game was then used as a means by which gentlemen afforded amusement to their guests with whom they filled their houses; and it was a very charming amusement. Game has now become a commercial affair, and he hoped the system would soon end in thorough bankruptcy." †

That the excessive preservation of game is destructive of good husbandry, will not admit of a question. Not only are the farmer's crops injured and his profits curtailed thereby, but, in many instances, he is restricted by it in the management of the land. Clauses are inserted in leases to prevent the tenant from drilling his turnips, because the partridges will run between the drills, instead of getting on the wing. They must not mow their wheat or the stubbles, because it will destroy their shelter. Recently, a nobleman, in a midland county, issued peremptory orders to his tenants not to use a reaping-machine, on the same absurd account. This last outrageous attempt to establish a new and unheard-of species of feudal tyranny was met, as it deserved to be, by the determined resistance of the whole body of tenantry, and the order was either rescinded or allowed to remain ineffective. Endless are the instances of tyrannical interference and petty vexation inflicted upon the tenantry, on some estates,

* Corbet's Tract, p. 7. † Ibid.

on account of the game.* The wonder is that, under such discouragements, agriculture should have made the progress it has done the last fifty years. In fact, we find that those estates on which the game is most preserved are, as a general rule, the worst cultivated and the lowest rented; and at those periods when the hopes of the husbandman ought to be on the point of realisation, the fields near the cover, on such estates, exhibit a scene of devastation and failure enough to discourage the most persevering cultivator.

Upon the game preserver himself, the influence of this excessive attention to a selfish practice, the effect is different, but, in a moral sense, quite as injurious. All his thoughts and feelings appear to be absorbed in this one object. His waking hours are occupied with plans for the protection and increase of his hares and pheasants. His sleep is disturbed by visions of poachers beating his preserves; or he is awoke up to the stern and unwelcome reality, by the discharge of guns, and the information that a poacher is *killed* or a keeper *murdered*. In youth and manhood, the preservation and pursuit of game form the principal business of life; and in his declining years and last moments, the puerile and unworthy subject occupies his mind to the exclusion of every higher consideration which ought to prevail at those serious periods of life, and in the prospect of leaving the world.† An elegant writer of the present century, in describing the pleasures of a rural independence, thus expresses himself on this subject:—"It is certain, that, in point of present gratification, every pleasure is such as it is felt to be; and therefore, if any one finds himself delighted in wandering through the woods with his fowling-piece, or in scouring the country along with dogs and horses, and desperate riders, to the terror of an innocent quadruped, it would be in vain to dispute against his experience. To what persons, or in what cases, such diversions are allowable, I leave others to determine; I shall content myself to observe, what I suppose none will deny, that when they are made a principal object, their manifest tendency is to induce an incapacity for nobler enjoyments, and so to lay the foundation of a despicable old age. For it would seem difficult to imagine a character more entirely sunk, and devoid of all respectability, than that of an old worn-out sportsman, the vigour of whose days has been wasted in mere animal exertions, and whose memory is stored with nothing better than the history of hares and foxes, of rustic adventures and perilous escapes; and who dreams away the evening of life, like the hound sleeping upon his hearth, in retracing the vain images of his wild and sportive excursions."‡

* The writer was once at a farmhouse in Norfolk, standing on the edge of a plantation: some of the farmer's children were amusing themselves (it being holiday time) in firing off a small cannon, with a bore about the size of a quill. Presently came the "squire" with a couple of keepers, to know who had been shooting. The case was humbly explained by the tenant, who happened to be at home; but he got a severe rebuke for allowing his children to disturb the game. He himself was not suffered to use a gun, even to frighten the crows off his corn.

† The writer knew one such character, whose *summum bonum* of life was to follow the hounds or beat the covers by day, and join in the debauch at night. The day on which he died, and within an hour or two of the crisis, he expressed his *last wish*, that he "could see all the wine-bottles he had drank out placed before him, for he was certain they would fill a large barn!"

‡ Bates's "Rural Philosophy," p. 249.

SECTION IX.

TERRITORIAL CUSTOMS.

Customs.—In agriculture, this word is either of general or local application, and implies the existence of certain rights, privileges, obligations, duties, &c., which, without any specific statute to enforce them, yet by reason of their antiquity, and the common and tacit consent of the people, possess all the force of law. It is, in fact, upon such rights, established by immemorial use and exercise, that the common law is founded; and the exponents thereof are the judges in our several courts, who, by reason of their superior knowledge and large experience, are considered best qualified to give a decision in respect to the validity or antiquity of a custom, and of the various circumstances by which it can be established. For this purpose a custom must be proved to have existed so long that the memory of man cannot reach its origin, or prove a contrary or hostile practice. If its beginning can be spoken to as of date within memory, it is void. It must also be continuous; because a cessation implies a relinquishment on the part of those whose interest or business it is to keep it up: and, in that case, a resumption would be considered a commencement, which may be successfully resisted on the ground of an intrusion and invasion of rights. Tacit or peaceable consent of all parties is another condition for the validity of a custom; because if disputed, it proves that it is not by common consent that it was established. Lord Chief-Justice Coke says that a custom to be valid must also be reasonable (1st Inst. 62). A custom must also be compulsory if established by common consent, and other customs must be in accordance with it, or there will be a clashing of interests that must neutralise one or the other, or both.

The common law of England is comprised of a body of the *Lex non Scripta* of local customs, first collected by King Alfred, and afterwards by Kings Edgar and Edward the Confessor. In bringing these local customs into harmony, in order that the whole kingdom might enjoy the benefit of an equal code of laws, there was a general consent of the inhabitants of the several districts to surrender such of their customs as might seem to be inimical to, or to clash with, the interests of the community at large. But owing to causes which it is impossible to explain, and which have long been forgotten, several counties, cities, towns, manors, and lordships were allowed the privilege of retaining certain of their local customs, which are different from those of the country at large, and at variance with the statute law of the land, except that they have in many instances been confirmed to them by acts of parliament.

Lands held of the sovereign were subject to various customs or services, known in ancient tenure by the names of Grand Serjeanty, Petit Serjeanty, and many other terms. Tenure by grand serjeanty is where a man holds lands of the crown by such services as he ought to do in his proper person to the king—as to carry the banner of the king, or his lance, or to lead his army, or to be his marshal, or to carry his sword before him at his coronation, or to be his carver, or butler, or one of his chamberlains of the receipt of his Exchequer, or to do other like services, &c. We shall now give examples of the various kinds of service and customs by which the land was held, whether of the sovereign, of the lords of manors, or as between man and man as successive owners and occupiers of the soil.

1. Hugh de St. Phillibert held the manor of Creswell, in the county of Berks, by the serjeanty of carrying bottles of wine for the breakfast of our lord the king, and it was called the serjeanty of Huse throughout the kingdom of England.

2. Ela, Countess of Warwick, held the manor of Hoke Norton, in the county of Oxford, which was of the barony of D'Oyly, of our lord the king, *in capite*, by the serjeanty of carving before our lord the king on Christmas Day, and to have the knife of our lord the king with which she carved.

3. Henry de la Wade held ten pounds of land (or land worth or rented at ten pounds) in Staunton, in the county of Oxford, by the serjeanty of carrying a gerfalcon every year before our lord the king whenever he should please to hawk with such falcons, at the cost of the said lord the king.

4. Reginald de Grey held the manor of Waterhill, in the county of Bucks, of our lord the king, by the service of finding one man upon a horse without a saddle, value 1*s.* 3*d.*, and one bow without a string, and one arrow without a head, when the king should command him for his service for the said manor to be in his army.

5. Peter Spileman paid a fine to the king for lands which the said Peter held by the serjeanty of finding an esquire with a haubergelle, or coat of mail, for forty days in England, and of finding litter (straw) for the king's bed, and hay for the king's palfrey, when the king should be at Brokenerst, in the county of Southampton.

6. Robert the Marshal, about the time of Henry II., held one hide of land in Baden (Essex) by the serjeanty of keeping the king's palfrey.

7. Edmund Willoughby held one messuage and six bovats* of land in Carleton, in the county of Nottingham, as of the manor of Shelford, by the service of one catapulta† by the year for all services.

8. Felicia, wife of William Martell, died 36th Henry III., holding of the king, *in capite*, ninety-eight acres of arable, four and a half of meadow, three of pasture, and 14*s.* 4*d.* rent of assize, in Rymehall, by the service of finding one esquire with a purple lance and an iron cap for forty days.

9. Robert Baudet held a certain serjeanty in Redburgh, for which he was to pay

* A bovate or oxgang of land was as much as one ox could plough and till in one year, or about fifteen acres, varying according to the soil.

† Catapulta, an engine to shoot darts with.

yearly at the Exchequer one hundred barbed arrows. And he also held one yard-land in Yentis and Andover by the same service.

10. Walter de Burgh and his partners held sixteen pound lands in Rakey, in the county of Norfolk, by the serjeanty of paying two mues (muids) of red wine, and 200 pears, called permeines, to be paid at the Feast of St. Michael, yearly, at the king's Exchequer.

11. When the king himself came to Chester, every carucate yielded him 200 fowls and one tun of ale, and one rushin of butter.

12. William Gardinar held seven acres of land in Lancaster by the service that he should find in (for) the castle pot-herbs and leeks, and his land was worth 2*s.* 4*d.*

13. Thomas de la Puille held on serjeanty in the town of Guldeford, of the gift of Testard, for which he formerly used to keep the laundresses of the king's court; and he paid at the Exchequer 25*s.*

14. Margery de Aspervil held one yard-land of our lord the king, *in capite,* in Aylesbury, in the county of Bucks, by the serjeanty of keeping all the distresses made for the king's debt by the summons of the Exchequer.

15. In the year 1285 it was found that Nicholas Attenasse held a virgate of land by the tenure of providing a pound for the king's bailiff of the hundred to impound cattle, by the sheriff's precept and summons of the Exchequer, and the bailiffs used to receive 6*d.*

16. Joan, wife of John King, holds a certain serjeanty in Stainhow, in the county of Norfolk, by the service of keeping braceletttum * deymerettum of our lord the king.

17. Sir Richard Rockesby, Knight, held lands at Seaton, in the county of Kent, by the serjeanty of being the king's vautrer† in Gascony until he had worn out a pair of shoes of the price of 4*d.*

18. Godfrey de Barenton held half a yard-land in Hethfield by the serjeanty of keeping the king's park and wood in the same town.

19. John Peckham held the manor of Peckham, in Kent, *in capite,* of our lord the king by the service of mewing one goshawk yearly.‡

20. Thomas Winchard held land in Conington, in the county of Leicester, *in capite,* by the service of saying daily five *pater nosters* and five *ave Marias,* for the souls of the king's progenitors and the souls of all the faithful departed, for all services.

21. John Freeman held one yard-land in Marden, in the county of Hereford, by the serjeanty of measuring the ditches and works of our lord the king at the cost of the said king.

22. Robert Fitz Alexander held the manor of Wrencholm by keeping the king's hogs from the time of pawnage until they were appraised.

23. Roger de Leyburne held Bures, and Robert de Sutton of him, by the serjeanty of scalding the king's hogs.

24. In the sixth year of King Edward I. (anno 1278), after the making the statute of *Quo Warranto* in the parliament held at Gloucester, the king, by his justices, questioning certain of his great subjects by what title they held their lands; among others John, Earl Warren and Surrey, being called and demanded by what warrant he

* From *brache,* a hound, or beagle.

† Keeper of greyhounds.

‡ A *mew* was a place of confinement where a hawk was kept till he had moulted.

held his, showed them an old sword, and unsheathing it, said, "Behold, my lords, here is my warrant; my ancestors coming into this land with William the Bastard, did obtain these lands by the sword, and I am resolved by the sword to defend them against whomsoever shall endeavour to dispossess me; for that king did not himself conquer the land and subdue it, but our progenitors were sharers and assistants therein."*

25. John de la Haye took of William Barnaby, Lord of Lastres, in the county of Hereford, one parcel of land of the demesne lands, rendering therefor 20*d.* yearly, and one goose fit for the lord's dinner, on the Feast of St. Michael the Archangel, suit of court, and other services thereupon due. Blount says, in his "Glossographia," that in Lancashire the husbandmen claim it as a due to have a goose *intentos* on the sixteenth Sunday after Pentecost, which custom took origin from the last word of the old church prayer of that day—"Tua nos quæsimus domine gratia semper præveniat et sequatur: ac bonis operibus jugiter præstet esse *intentos.*" The common people take it for a *goose with ten toes.*

26. A farm at Brookhouse, in Langsett, in the parish of Peniston and county of York, paid yearly to Godfrey Boswelle, Esq., a snow-ball at Midsummer and a red rose at Christmas.

27. At Lavenham, in Suffolk, and Maldon, in Essex, the inhabitants have a tenure of land which Littleton, the famous lawyer, calls "Borough-English," namely, that the younger sons inherit the lands and tenements which their fathers had in this manor, if they happen to die intestate. In Maldon it is limited to the youngest son.

28. An estate in the parish of Hedsor, Bucks, called Lambert's Farm, was formerly held under the manor by the service of bringing in the first dish at the lord's table on St. Stephen's Day, and presenting him with two hens, a cock, a gallon of ale, and two manchets of white bread: after dinner, the lord delivered to the tenant a sparrow-hawk and a couple of spaniels, to be kept at his cost and charges, for the lord's use. A composition is now paid in lieu of this service.

29. Within the precincts of the manor of Temple Tisoe, in the county of Warwick, is cut, upon the side of Edge Hill, the figure of a horse in large shape; and because the earth is red, it is called the Red Horse, and gives the denomination of the fruitful vale about it, called the Vale of the Red Horse. The trenches about the horse are cleared every year by a freeholder, who holds his land by that service.

30. In the manor of Gimmingham, Norfolk, the ancient custom of socage is still kept up—the tenant not paying his rent in money, but in so many days' work.

The whole town of Cawston, Norfolk, is an ancient demesne, and enjoys the privilege of that tenure, as also of the duchy of Lancaster, of which this manor is a member, and, consequently, within its liberty, but was exempted from the jurisdiction of the duchy by John of Gaunt, Duke of Lancaster; in token whereof, at this day, a brazen gauntlet (or hand) is still carried before the lord of the manor or his steward whenever they hold court there, on the same day, as the device or rebus of John of Gaunt, Duke of Lancaster, who assigned all the royalties to be held of him by the lords of the manor, and the plough coulter in the hand denotes the manor to be held in free socage, and not *in capite,* or by knight's service.

* William, first Earl Warren, was, at the time of making the general survey (Doomsday), possessed of two hundred lordships in several counties of England, whereof Conesborough, in Yorkshire, was one which had twenty-eight towns and hamlets within its soke.

31. The manors of East and West Enborne, Berks, have this custom—that if a copyhold tenant die, the widow shall have her *free bench* in all his copyhold lands while she continues sole and chaste; but if she commits incontinency, she forfeits her widow's estate; yet, after this, if she comes into the next court held for the manor, riding backward upon a black ram, with his tail in her hand, and says the following words, the steward is bound by the custom to re-admit her to her free bench:—

"Here I am,
Riding on a black ram,
Like a w—e as I am;
And for my crincum-crancum,
Have lost my bincum-bancum;
And for my tail's game,
Am brought to this worldly shame;
Therefore, good master steward, let me have my lands again."

A similar custom exists in the manor of Torre, in Devonshire, and other parts of the west.

32. In the manor of Builth, county of Radnor, every tenant paid maiden rent, viz., a noble, at their marriage, anciently given to the lord for his omitting the custom of *morchetta*, whereby he was to have the first night's lodging with his tenant's wife: but it was more probably a fine for licence to marry a daughter. This tenure is still subsisting; but the lord generally chooses to tap a hogshead of cider rather than have the virgin.

33. In town of East Rudham, Norfolk, the custom of all the lands which are held within the borough concerning,—in-penny and out-penny, is this that he who would sell or give the said tenure to any one, shall give for his going out of the same tenure one penny, and the like for the entry of the other; and that the bailiff of the lord shall be present at the delivery of every livery of seisin, and if the aforesaid pennies shall be in arrear, the bailiff of the lord may distrain for the said pennies in the same tenure.

34. It has been the custom at Ensham, in Oxfordshire, for the townspeople on Whit Monday to cut down and bring away (wherever the churchwardens pleased to mark it out by giving the first chop) as much timber as could be drawn by men's hands into the abbey yard, whence, if they could draw it out again, notwithstanding all the impediments that could be given by the servants of the abbey, and since that by the family of the lord, it was then their own, and went, in part at least, to the reparation of the church. And by this custom, as some will have it, they hold both their Lammas and Michaelmas common.

35. It is the custom of some manors within the honour of Clun, in the county of Salop, that at the entrance of every new lord of that honour, the tenants shall pay him a certain sum called mise-money. In consideration whereof they claim to be quit of all fines and amercements, which are recorded at that time in the court rolls and not levied, which they call "white books."

36. In the manor of Dunmow, in Essex, a custom still exists, by virtue of which any couple who can make oath that for a year and a day after their marriage they have not had any quarrel, or repented of their marriage, sleeping or waking, can claim a flitch of bacon of the lord or his steward. This custom is said to have been instituted by Robert Fitzwalter, in the time of Henry, son of King John, when the claiming of the flitch was a time of solemnity and triumph with the monks and townspeople; and it is still

kept up, and the bacon has been claimed within a very few years. The following is the form of the oath taken on these occasions:—

"You shall swear by custom of confession
If ever you made nuptial transgression.
Be you either married man or wife,
If you have brawls or contentious strife,
Or otherwise at bed or board
Offended each other in deed or word;
Or since the parish clerk said Amen,
Yo wished yourselves unmarried again,
Or in a twelve-moneth and a day
Repented not in thought any way,
But continued true in thought and desire,
As when you joined hands in the quire.
If to these conditions, without all feare,
Of your own accord you will freely sweare,
A whole gammon of bacon you shall receive,
And beare it hence with love and good leave;
For this is our custom at Dunmow well known,
Though the pleasure be ours, the bacon's your own."

37. The custom of the manor of Ham, in Middlesex, is, that if any copyholder will sell his land, and agree upon the price at the next court, the next *cleirenor* (*i. e.* he that dwelleth next to him) shall have the refusal, giving as much as another will; and he which inhabits on the east, first, and the south and the west next, and the north last.

38. By the custom of the manor of Pannington, an infant of twelve years old may surrender.

39. By the custom of the manor of Reigate, Surrey, any tenant may fell timber-trees upon his copyhold without licence from the lord, provided such timber be employed about building and repairing his copyhold; and likewise if a tenant dieth seized of several freehold lands and tenements, there is but one heriot due to the lord. And if a tenant die seized of several copyhold lands and tenements, the lord shall have but one heriot.

40. The custom of the manor of Sedgeley, county of Stafford, is, if a copyholder make a lease without licence of the lord, for one year, and dies within the term, it shall be void against the heir; and this was adjudged to be a good custom by the court, in the case of Turner *v.* Hodges.

41. Every tenant of the manor of Writtle, in Essex, upon St. Leonard's Day (6th November), pays to the lord for every pig under a year old a halfpenny, for every yearling pig a penny, and for every hog above a year old twopence, for the privilege of pawnage in the lord's woods; and this payment is called *avage*, or *avisage*.

42. In Norfolk there are some grounds which it is not known to what parish they certainly belong; so that the minister who first seizes the tithes, does, by that right of pre-occupation, enjoy them for that year; and the land of this dubious nature is there called *catch-land*, from this custom of seizing the tithes.

43. At Maldon, in Essex, there is a custom claimed by the name of *land-cheap*, which is, that for certain houses and lands sold within that borough, 13*d.* out of every mark (13*s.* 4*d.*) of the purchase money shall be paid to the town; which custom of *land-cheap* is claimed by a grant made to that town by the Bishop of London, anno 5th of Henry IV.

44. In the manor of St. John of Jerusalem, at Islington (*Iseldon, Bernersbury*),

lands descend according to the custom of Borough-English, whereby the youngest son of a copyholder inherits; or in default of issue, the younger brother. The fines are arbitrary, and at the will of the lord, whose custom is to take two years' improved rent on a descent, and one year and a half on an alienation. No heriots are taken. Widows are entitled to dower of the copyhold.*

45. Lands in Highbury, Middlesex, descend according to the custom of gavelkind, being equally divided between male heirs in the same degree of consanguinity; and in default of male heirs, among females in the like manner. The copyholders pay a fine arbitrary at the will of the lord. No heritors are now demanded, nor have there been any for many ages; but 6*s.* 8*d.* appears to have been once paid on that account in the reign of Henry VII. Widows are not entitled to dower of the copyhold.†

46. In the manor of Terrington, Sussex, the tenants are obliged to do certain work by the rod, which is called *rod-gavel.*

47. In the manor of Wadhurst, Sussex, there are two sorts of copyholds, viz. *stock-land* and *bondland.* If a man be first admitted to stockland, and afterwards to bondland, and dies seized of both, his heir shall inherit both; but if he be first admitted to bondland, and afterwards to stockland, and dies seized of both, his youngest son shall inherit.

48. Most of the grounds round Whittlesea, Isle of Ely, county of Cambridge, are marsh, for which King Canute gave orders to Twikill the Dane, that every village about the fens should have its proper marsh, and so divided the ground that the inhabitants of each village should have just so much of the marsh for its own use as lay right against the farm ground of the said village. He also made an order that no village might dig or mow in another man's marsh without leave; but, however, that the feeding should be common to all, that is, horn under horn, for the preservation of peace and quiet among them. The fens at this day are divided among the inhabitants as mentioned in this order.

49. In the honour of Clun, Salop, sute silver, *i. e.* a small rent or sum of money, if paid, does excuse the freeholders from their appearance at the courts-baron within the honour.

50. Two farms lying in the township of Swinton, Yorkshire, and which belong to Earl Fitzwilliam, late in the occupation of John Mercer and Richard Thompson, every year change their parish for one year. From Easter Day at twelve at noon, till next Easter Day at the same hour, they lie in the parish of Mexbrough; and then, till Easter Day following, at the same hour, they are in the parish of Wath-upon-Derne, and so alternately. These farms consist of about 302 acres.

51. In the manor of Kenton, Devon, if the issue of any tenant hold their tenements, one after another, three descents, they may claim the inheritance of the tenement.

52. In the manor of Kennington, Surrey, lands descend to the youngest son; and in default of sons, are divided equally among the daughters.

53. In the manor of Richmond, Surrey, lands are held by the rod, or copy of court roll, and descend to the youngest son, or in default of sons, to the youngest daughter. The same customs prevail in the manors of Petersham and Ham.

The first twenty-four of the foregoing cases were of grand and little serjeanty, and the remaining twenty-nine, manorial customs. The whole were selected from Beckwith's

* Wilson's "Hist. of Islington."

† Ibid.

edition of Blount's "Fragmenta Antiquitatis," and present ample and curious illustrations of the simple manners, and, in some instances, ludicrous customs, by which, in the early periods of our history, the tenure of real property was accompanied. Some of the former class, and most of the latter, are still in force, and will probably remain so as long as the present law of inheritance and of entail continues—at least on some manors; but the act of parliament for facilitating the conversion of copyhold property into freehold, will, to a considerable extent, do away with these feudal tenures, and place the land of the country upon an independent footing, so far as the manorial system is concerned.

The present law of inheritance and of entail, by which real property descends to the eldest son, is perhaps the most effectual bar to the improvement of the land that can possibly be conceived, especially when the condition of the real property of the kingdom is taken into the account. It is estimated that not more than from one-half to one-third of the actual rental of the land remains to the nominal owner—the other half or two-thirds being paid to mortgagees, annuitants, jointresses, and other claimants. And when it is further considered, that none of these latter are burthened with any charges upon their share of the rental, but that the expense of management and whatever losses may accrue are sustained by the proprietor, who has also to uphold, out of his share, the honour and dignity of the family, and to make provision for the younger branches, no surprise can be felt at the hesitation of the proprietor of an entailed estate to effect permanent improvements upon a property which, as life is uncertain, may to-morrow go to enrich, by his death, the eldest son, to the injury of the rest of his children.

It is further calculated that at least two-thirds of the land of England is entailed. Two acts have of late years* been passed to enable the owner of an entailed estate to borrow money of the government, or otherwise, for the purpose of effecting improvements, such as drainage, the erection of buildings, &c., to be repaid by annual instalments sufficient to cover principal and interest in a certain number of years, the debt to remain in shape of a rent-charge upon the property until the whole is paid. This certainly is a move in the right direction; and many of the landowners have availed themselves of the acts, finding their tenants very willing to pay an additional rent to enable them to cover the rent-charge. At the same time, the plan establishes a charge on the heir to the estate in manner of a tenant-right; and instead of receiving the property upon a demise clear, or with only the old encumbrances upon it, he finds that he has to pay out of the rental the additional value of the unexhausted improvements effected by his ancestor.

Another bar to improvement by a tenant of land is the act of the 6th of Edward I., called the Statute of Gloucester, by which it was ordained that "*what is fixed on the soil, goes with the soil.*" Originally, this stringent law extended to commercial real property, or tenements; but the rule has been relaxed in regard to fixtures in dwelling-houses, manufactories, mills, &c., these being now accounted the property of the tenant who puts them up, and who can take them down again, upon leaving, unless paid for by the landlord or the in-coming tenant. Not so, however, with agricultural fixtures, which having once been fixed to the ground, remain the property of the landlord, however costly they may have been to the tenant. How the distinction

* 9th and 10th Vic. c. 101, and 12th and 13th Vic. c. 100.

between commercial and agricultural property came to be thus made, or what constitutes the difference that entitles one to a claim which is denied to the other, it is difficult to imagine. Be this, however, as it may, the law, in the case of agriculture, is an effectual bar to improvement by a tenant, especially a yearly tenant or tenant-at-will. Nor, indeed, can the owner of an entailed estate guarantee to a tenant his outlay for permanent improvements, having himself only a life-interest in the property, and that under heavy drawbacks and disadvantages.

Such are some of the principal impediments under the operation of which the land of England is suffered to remain, and by reason of which agriculture is kept back from that progress and improvement of which it is capable, and by which the produce of the soil might be indefinitely increased. To them may further be added the system of covenants insisted upon by the proprietors of many estates; but these will be treated of in the next part of this section, namely, "The relative positions of landlords and tenants, their rights and duties."

We have already referred to the character of the feudal possession of the land, and traced it from the general ownership of a tribe or its representative, through the various stages of the conventional tenure, until it became the freehold of the possessor, who, by virtue of a legal title, has complete power over it, unless the interests of society at large demand a partial or a total surrender of it,* in which case an equivalent is given. On the other hand, the proprietor of an estate, if not entailed, can sell the whole or a part thereof, or can let it on lease or otherwise, of a longer or shorter date, as circumstances may dictate. But if an estate is entailed, he can only let the land for the term of his own life; but during that term he is the landlord, and has the power of exercising all the rights which appertain to that relation, in the qualified disposal of it.

The word "landlord" originated at a period when the possession of land imparted almost a regal power and distinction, and when it was the only property that conferred, or admitted of, nobility, or of even a claim to personal freedom. In the earlier periods of our history, after the Romans had withdrawn, and the terrible Saxons had established themselves upon Roman civilization, it might have been expected that they would have adopted the municipal system of their predecessors, and that cities and towns would have been points of attraction to them. Such, however, was not the case. The taste of the Saxons was directed to a secluded rural life and the possession of land. Their dwellings were chiefly placed apart, and wherever a spring or a running stream tempted them to fix it. Voluntary associations were formed for the purposes of mutual protection and mutual benefit; but all their ideas of social life were based upon a property in land, and every other mode of life, independent of it, was considered inferior and degrading.

It was therefore in proportion to the extent of land appropriated by an individual that his standing in society was estimated. The term "baron," which now implies

* Many years ago a bill was introduced into the House of Commons for the construction of a canal which, according to the plan proposed, would have passed through the park belonging to the Braybrooke family, at Audley-end, near Saffron Walden. The bill went through its regular stages in the Commons' House; but when it was taken up to the Lords, the then Lord Braybrooke rose to oppose it. He represented that he had expended immense sums in improving the estate, and in the construction of the ornamental lake, through which, within sight of the windows of the mansion, it was proposed to bring the canal. Bursting into a flood of tears, he besought their lordships not, by passing the bill, to consent to such a desecration of an ancient estate, on which his family had so long resided, and which to him was doubly valuable for the care he had bestowed upon it to render it worthy of his successors. We believe the bill was at that time thrown out by the Lords.

nobility, was originally used to indicate "a freeman." * And on the other hand, the term "landlord," which now simply means the person who lets land or a tenement to a tenant, but of itself involves no further distinction, was very differently understood in ancient times, when, from the scarcity of money and the almost total absence of trade and manufactures in rural districts, the land was the only source of riches, and the possession of it the only basis of power and influence. In this, as well as in every other case of the kind, we must be understood always to except the church, which, apart from all other portions or classes of society, was possessed of both power, wealth, and influence, their claim to which was tacitly acknowledged by all others. This, however, did not in the least detract from the distinction which the possession of land gave to a layman, or from the power which it enabled him to exercise as the "lord of the soil." And although the harsher features of feudalism have long since passed away, there is enough of the spirit of it in our laws at present to impress the tenant of a large landowner with a sense of his dependence. The power, too, that this tacit acknowledgment imparts is not unfrequently exercised to the prejudice of the tenant, and as much to the injury of the estate.

The present relative position of landlord and tenant is not, however, that of a master and serf or slave, nor ought it to be that of a superior and a dependent. The day is gone by when the possessor of land could, like the Russian lord, reckon the number of his slaves by that of his tenants. The relation these hold to each other is of a perfectly commercial character, and, like all other commercial relations, the more liberally and justly the spirit in which they are conducted, the more advantageous is the connection to both parties. Nor ought there to be any other sense of obligation on either side than that universal one which, as members of a community, we strictly owe to each other, and specially to those with whom we are brought into immediate and close contact. Beyond this general law of society, there is no particular claim which the owner of land has upon his tenants apart from the agreements into which they both enter. If A. has a farm to let, and B. is in want of one, and they can agree upon the terms and covenants, there is no special obligation on either side apart from that which attaches to any other commercial transaction. On the other hand, there is a mutual obligation to fulfil the stipulations entered into; and while, on the one part, the tenant must take care not to do anything to damage the property by an injurious system of cultivation, the landlord is bound in honour and justice to avoid all undue interference with the tenant that will prevent him from fairly making the most profit out of the land during his term in it.

If these relative duties are not in the present day so universally understood or acknowledged by either party as they ought to be, it is because for a long series of years the landed interest, as it is called, had a paramount influence in the legislature. In former times this was almost a necessary consequence of the position which the proprietors of real estates held in the country. Independently of the access which their territorial wealth gave them to the court and the ruling power, the leisure it afforded them, in being exempt from the labour of business of an ordinary kind, peculiarly fitted them to undertake the office of legislation; and the actual ownership of boroughs enabled them without difficulty or expense to take their seats in parliament. This was still further provided for by a statute of parliament, which rendered landed property to

* See Coke, "On the Inst. of Littleton," lib. i. sect. 1 and 9.

the value of £300 a year indispensable to the possession of a seat in the House of Commons.* The power thus obtained, and which has been freely made use of in the promotion of the views of the "landed interest," made ample amends for the loss of the feudal rights and prerogatives they had relinquished or been deprived of.

The annihilation of the class of yeoman freeholders, which was formerly so numerous, and the absorption of their small estates into those of the larger landowners, formed an era in the history of the land of England. It raised up a new class of tenant-farmers possessing capital, whilst the great advance in the value and the rental of land consequent on the high price of produce and the superior cultivation, was also partly the result of the competition for land which all at once took place throughout the country. But notwithstanding this competition, the respectable position of those who thus became converted from freeholders to tenant-farmers, gave them a weight and influence with the owners of the property they hired, which greatly improved their condition, and rendered them more independent. At the same time, two other interests arose in the country, which, during the last half century, have come into direct collision with that of the land, and effected changes bearing heavily upon the political influence of the landed aristocracy of the country. These are the commercial and the moneyed interests, both of which have assumed so high a position in the country as to outweigh in a financial point of view that of the land; and one of the most important of those changes was the entire abrogation of the property or landed qualification for a seat in the House of Commons. We have no hesitation in saying the abolition of this test was the real and immediate cause of those changes in the commercial policy of the country which have thrown open our ports to the trade of the whole world.

The position in which the adoption of free trade has placed the agriculturist, necessitates a change in the disposition of the land. The free competition to which the cultivator of the soil is subject, renders it imperative that every impediment to his success, and to the improvement of the land, should be removed. While the law of entail and that of primogeniture exist, and are in full force, it is impossible that progress can be made commensurate with the requirements of the country, or the interests of the occupiers of land. On the other hand, the system of granting leases must supersede the yearly tenancy, or that at-will, both of which are relics of a barbarous age, when the cultivation of the soil was of a rude kind, and the cultivator himself but one degree above barbarism in knowledge. It may be laid down as an axiom, that no man can farm fearlessly and well upon a yearly tenure, nor can he afford to give the same rent for the land on such a tenure that he could upon a long lease. And whatever argument a landlord may adduce for adhering to such a system, it cannot contradict the fact that the improvement of the land is impossible under it, and that, therefore, it is as contrary to his interest as it is to that of the tenant.

On this subject, the following passage from a modern work is much to the purpose. "Of all the encouragements to the tenant-occupier that exist, of all the stimulants to individual employment that can be devised, the surest and most legitimate, and, in truth, the easiest and most permanent in effect, is to make every tenant feel to the utmost possible degree that the farm to which he devotes his labour and capital is HIS OWN. 'Give a man the *secure possession* of a bleak rock,' says Arthur Young, 'and he will turn it into a garden. Give him a nine-years' lease of a garden, and he will convert it

* Statute 9 Anne, ch. 5.

into a desert.' Without going the length of the latter half of this proposition, we may nevertheless take the broad principle it asserts as the touchstone of all true suggestion that can be offered in reference to the relation that exists between the landowner and the farming-occupier. A relation purely factitious and founded in no natural or necessary condition of mankind, open to the action of a perfectly free will on either side to arrange its terms by a special agreement, or to accept that which the law supplies, such as it may be, is one, to which the attempt to dictate a string of imported obligations is in the highest degree irrelevant, and loaded with a tendency to mislead those who, like the tenant, most require to be guarded from acting on erroneous assumptions. To be able 'to do as he likes with his own' is, fortunately, a definition of human privilege, the boast and extravagance of which exist only in the sound. A thousand obligations and influences surround the will and conduct even of the most apparently irresponsible and unfettered owner, controlling him by an operation far better and less easily evaded than legal compulsion, to consult his own interest by consulting that of others. . . . . If it be true that the best tenant is he who treats the land as if it were his own, it can scarcely need proof that the best landlord is he whose tenant is least made sensible that he is not his own landlord. Paradox as this might once have seemed, and may still appear to some, it is the only statement that approaches the whole truth of the case. The relation is one of that class, which, like the functions of animal life, are most healthily discharged when they are not felt."*

The encumbrances upon the land are a terrible drawback upon its improvement and prosperity: that a vast number of landowners would be far better off if they could sell enough of their real estate to pay off those encumbrances there cannot exist a doubt; and if any one is disposed to question this fact, we would at once refer him to the operation of the Encumbered Estates Court in Ireland. When the act was first passed it raised an immense clamour from the "landed interest" in that country as well as in England; and its adversaries represented it as an act of spoliation, if not of robbery; and yet, before four years were expired, a large proportion—probably half—of the petitions to the court were from proprietors of estates themselves. They had found, from the example of others, that it was far better to have half their properties unencumbered, than the whole with a load of debt which prevented all improvement.† That such an act, and such a court is wanted in England begins to be felt by many of the landowners themselves; and although there would doubtless be a powerful opposition to such a measure in parliament, the necessity of the case will in time ensure its adoption, unless some other expedient can be found to alter the laws affecting real property, and place it upon the same commercial and social footing as other property.

Of the game laws, and the system of game preserving now generally adopted, and which are becoming daily more glaringly injurious both to the occupiers of land and to the country at large, we have already spoken. That they are a grievous wrong inflicted

* See Morton's "Cyclopædia of Agriculture," article "Landlord," p. 200.

† One single case we will adduce in point. The estate of Mr. B. in County Galway had a nominal rent roll of about £4,000 a year, but so overwhelming were the encumbrances of all kinds that the nominal owner received only £300 a year clear. As a *pis aller* he petitioned the court for a sale. It was a neck-or-nothing throw of the dice, but it succeeded. The worst lands of the property were put up first by the commissioners, and enough having been sold to pay off every claimant in full, Mr. B. found at the close of the business, that instead of an income of £300, he had an unencumbered income of £1,100 a year with a parliamentary title good against the whole world! At the present high value of land, how many English landowners might improve their condition in the same manner if they had such a court to assist them.

by the landlord upon his tenants will not admit of a question. That they are as injurious to the one as to the other, in both a moral and a social sense, is also indisputable. As the principle arises out of a selfish desire to gratify vanity and the love of amusement at the expense of others, so the determination to satiate that desire superinduces a general disposition of selfishness in every transaction with the dependents of such a landlord; and whatever outward forms of respect may be paid by them, there can be but little real feeling of it when in walking through their fields they behold the waste and destruction of their crops as the result of their landlord's selfishness; and if policy constrains them to "bless him with their mouths, they curse inwardly" the reckless indifference with which he breeds up a stock of vermin called "game" at the expense of others. Thus the bonds of mutual esteem, and the mutual desire to promote each other's welfare are annihilated, and the relationship between landlord and tenant is only maintained "at the point of the bayonet," as it were—the landlord jealous of the destruction of his game, the tenant of that of his crops; and both exasperated to the utmost by the espionage and earwigging of the *sbirri* of the estate, the unprincipled gamekeeper, the great fomenter of disputes between the game preserver and his tenants.*

The relationship existing between such landlords and their tenants is one of hostility, and not of mutual esteem and consideration; of tyranny and injustice on the one hand, and of helpless and hopeless exasperation on the other. It was not for such a purpose, or such a condition of things, that the just laws of either God or man created that relationship, or on which the possession of land is bestowed; the human laws which have subjected the land to such an infraction of those of the universe, and which smite the earth to a certain extent with "blasting and mildew," were the offspring of a barbarous and ignorant state of society totally different to that which now exists; and it argues but little of either good sense or right feeling, that the evils the game laws have inflicted upon the country should be still further aggravated and increased by the new mode of pursuing the sport, which renders necessary a much larger accumulation of game to make it of sufficient importance.

The total disregard by many landlords of the obligations under which their relationship to their dependents places them, argues a misapprehension of their position, or a want of principle to lead them to act up to it. "*To do as they will with their own*" is their favourite maxim, and upon the strength of it they treat their tenants as if they were specially created to promote their pleasure and profit. Without reflecting on the fact that while they are as much interested in the permanent improvement of the land as the tenant, the expenditure of the latter in effecting those improvements gives him a prior claim to the profits, their aim is to avail themselves of the outlay, and make the farmer himself, or a successor, pay for them in additional or increased rent. This is one of the motives for yearly tenures, and its effect is to keep the land in an unimproved state, the tenant having no further interest in it than to get as much out of it as an imperfect system of cultivation will enable him.

* A friend of the writer's who has suffered by game to the extent of £500 a year, and who can obtain no compensation, is compelled to relinquish his farm on that sole account, being no longer disposed to put up with the interference of the gamekeepers in all his operations of husbandry.

PART II.—THE THEORY OF AGRICULTURE.

SECTION I.

HISTORY OF THE RISE AND PROGRESS OF AGRICULTURAL PRINCIPLES IN ENGLAND.

THE practice of agriculture is coeval with the history of man, and arises out of the necessities of his nature and constitution. Indirectly or directly, mediately or immediately, it is upon the vegetable productions of the earth that all animals are supported. The beast of prey feeds upon those which consume only vegetable food, and thus indirectly and mediately lives upon the same. There is no question of the truth of this simple proposition; but if we wanted a proof of it we find it in the fact, that the component parts or elements which go to constitute the animal, are also contained in the vegetable productions of the earth; and that the laws which govern the one are analogous to those which rule the other. The difference is that one possesses an active, the other a passive existence; the one enjoys sensation and the means of self-preservation, which are wholly absent in the other, so far as any perceptible manifestation is concerned. In their rise, progress, and final destiny there is a perfect analogy. Both have their infancy, youth, maturity, old age, decay, and death; and both after death, by one process or another, are subject to the same law of decomposition, the inevitable fate of all that is "of the earth, earthy."

The analogy may be carried still further without diverging from the subject. Both require light, warmth, food, rest, sleep, &c., for their proper and healthy growth and development. Thus, if a plant is placed in a pot, in a dark cellar, with only a small opening into the outer air, it will turn its head towards the feeble light, and endeavour to reach it with as much perseverance as an animal can evince. Again, plant a vegetable in a poor soil, and bury at a little distance from it a quantity of manure, the roots of the plant will immediately be directed towards the spot until it reaches it. Every one knows the effect of the warm sunshine and rain upon vegetation, and the injurious effects of a continued absence of them. The joyous appearance of the fields, described in the figurative language of the sacred writings by "the little hills skipping on every side," shows that in all ages the phenomenon of the "earth rejoicing" at the bounty of Providence has been observed.

The object of agriculture is to multiply the fruits of the earth to the utmost extent of which their nature is capable; and as man is the only being endowed with reason to enable him to do this, so every production of the soil, whether animal or vegetable, was given to him, and was specially created for his benefit and use. For however few in number may be those plants which are immediately applicable to his support, they all contribute in one way or other to his welfare. He cannot, it is true, live on grass, but he consumes the flesh and the milk of the animal that eats it, and is thus indebted to the pasture for the luxuries which animal food confers on him. Even those plants which by their poisonous or nauseous qualities are unfit for animal food, contribute to his comfort either as medicine in a curative capacity, or as materials in the construction of clothing to wear, or furniture for his dwelling.

The animal creation is equally fitted to contribute in one way or other to his enjoyment. Those of a domestic kind used for food are found to multiply with far greater rapidity than the wild animals or beasts of prey; and although some of these latter, such as the lion, the tiger, the wolf, &c., are of no use as food, their skins are available in the formation of useful or ornamental clothing. It is, however, only in wild and secluded countries that these latter are found, for history tells us that their extinction keeps pace with the advance of civilization, their presence being found incompatible with the increasing necessities or the safety of that condition of society.

We have no knowledge from history of the mode of cultivation employed in the earliest ages of mankind, having only the simple announcement in the oldest record extant, that "Abel was a keeper of sheep, and that Cain was a tiller of the ground." It is generally supposed that the sheep were not kept for food, but for clothing and the higher purpose of sacrifice. It is, however, difficult to imagine that these objects would alone consume the number of these and other animals of the edible species which their multiplication in a warm and fruitful country would demand; but whatever may have been the practice of the antediluvians in this respect, there is no doubt but that the practice of agriculture was the first and foremost industry of man, and we may assume that the knowledge of its principles were imparted to him, in one way or other by the same Power that endowed him with understanding and skill.

After the flood, we have two important announcements: first, that "every moving thing that liveth" was to be meat for him; and, secondly, that the year after he left the ark he "began to be an husbandman, and planted a vineyard;"* and the promise was given that "seed time and harvest, day and night, summer and winter, should not cease." No further intimation is afforded of the kind of cultivation pursued by the patriarchs and founders of nations, except incidental mention of the various periods of the agricultural year, such as "barley harvest," the baking of cakes upon the hearth, &c., until the time of Joseph, to which we have already referred. There can be no doubt that the nations of antiquity understood well, according to the light of science they possessed, the cultivation of the soil, and that it was practised to a considerable extent by the greatest characters of those ages. We learn from the ancient Greek poets,† and specially from the Elgin Marbles, that Ceres, who was a native of Sicily, went to Athens to instruct the Greeks in the practice of husbandry, and that she deputed her son Triptolemus to go to other countries for the same object. This was about 1400 years before the Christian era, or 900 years after the flood. It would appear from this that the inhabitants of Greece had lost the art after the dispersion of mankind at the building of the Tower of Babel, and this was the case also with other nations or tribes of people who in process of time were

* Genesis ix. 3, 20.

† Hesiod wrote on agriculture 944 years before the Christian era. Romulus established agriculture in Rome 753 B.C. Herodotus wrote on it 442 B.C.; Xenophon, 338 B.C.; and Cato, Varro, Virgil, and Columella in the first century of the Christian era.

scattered over the face of the earth. It would be foreign to our subject to enter into the question of the process by which any people have become so barbarous as to have entirely lost the most primitive and necessary of arts, and one the practice of which appears so obviously essential to the preservation of life. Certain it is, however, that such was the case with our forefathers, the ancient Britons, who, if they practised husbandry at all, did so in the rudest, simplest, and most imperfect manner. But little is known on the subject further than we may judge, that a people who lived in the woods and clothed themselves with the skins of the animals they took in hunting, or painted their bodies to keep out the cold, could not have been much advanced even in the very lowest branch of the arts of civilization.

It is generally supposed that the practice of agriculture was conveyed to the Britons from Gaul, and that previous to the settlement of the colonists from that country on the shores opposite to their coast, it was unknown.* The Romans found these colonists, when they arrived, peacefully cultivating the land they had taken possession of; and were so far from disturbing them, that they introduced great improvements. Neither the natives nor the Gaulish colonists were unacquainted at that time with the use of manure, for Pliny in his "Natural History," written in the first century, relates that they used both manure and marl, which he says was peculiar to them, and that its effects continued eighty years, for no man was ever known to marl his land twice. As lime was also used in Gaul at that period, as recorded by Cæsar in his Commentaries, it is not improbable that this practice also was brought by them into England.

After the Romans abandoned their conquest, and the incursions of the Picts and Scots became more frequent and destructive, agriculture declined, and instead of large quantities of wheat being exported to the continent, the country was frequently visited by famine. The invasion of the Saxons, far from reviving the art amongst the natives, rather sought to exterminate the whole race; and after an ineffectual struggle, and the massacre of the greatest portion of the people, the remnant retired into Wales, where the invaders, having taken possession of their lands, allowed them to remain unmolested in the mountains and fastnesses of that barren country.

Notwithstanding the local disadvantages of soil and climate in Wales, the refugees found means to cultivate the land to advantage, and made laws for the proper regulation of the art, affording every encouragement to those who practised it. But the case was very different with the Anglo-Saxons, who had robbed them of their territories. Their fondness for war disqualified them in a great measure for the more sober and peaceful pursuits of agriculture; and they even passed laws to prevent any freeman from practising it, and to confine the operations of husbandry to the women and slaves. Of these, however, there were not enough to cultivate sufficient ground to support their establishments, so that, to avoid being starved, they were soon compelled to assist in the processes of husbandry.

In the history of the appropriation of the land we have already adverted to the little that is known on the subject of ancient British agriculture, the materials for which are chiefly those interwoven with the general history of the country. Previous to the introduction of the art of printing in 1440 there were no writers expressly on agriculture, or if there were, their works have never come down to us. By the incidental notices, however, that are found in historical works, and which have been collected by modern writers, we

* This was the opinion of Cæsar upon his landing in the country.

may judge that both the implements of husbandry and its practice were of the simplest and rudest description. At the time of the Norman invasion the plough was a heavy machine made entirely of wood, having only one handle, with which the ploughman guided it, holding in the other hand a staff or pole wherewith he broke the clods and cleared and mended the plough. In Wales the man who led the horses or oxen (of which from four to six were used*) walked backward. The cattle were fastened with withs to a long whipple-tree, three abreast, the outside ones walking respectively on the ploughed and unploughed land, while the centre ones walked in the furrow. This, however, is less barbarous than the way of ploughing in Ireland in the middle of the last century. "I have very often seen a mare," says a writer who resided in that country, "and her offspring, a three year old, two year old, and one year old, colt, ploughing all abreast, two going upon the ploughed land, and two upon the unploughed, with neither hemp nor iron about them; their whole gearing consisted of a withy or twisted stick tied to the hair of the horse's tail, and so through a hole made in a long pole or stick, which reached the breadth of the four horses, and served by the way of a swingle-tree, which pole is fastened in the middle by another withy to a hole bored in the end of the plough-beam."†

The wars, both foreign and domestic, which incessantly ravaged the country, especially "the Wars of the Roses," were a great bar to agricultural industry. The damage continually sustained by the farmers in the destruction of their crops, and the demands made upon them, for the use of the sovereign, of large quantities of corn for the support of his armies abroad, gave them a disgust of the cultivation of grain, and it became a common practice to abandon it altogether, and devote the land to the rearing of cattle and sheep. To such a length was this system carried that a frequent scarcity of bread was felt, in some instances amounting to severe famine. Some of the large occupiers possessed 30,000 or 40,000 sheep, which, as the wool was always in request, were sure to remunerate them. It was considered that cattle or sheep could be more easily removed than corn or other vegetable produce, and were therefore more safe from the ravages of marching troops, as well as less liable to be demanded as a contribution by the sovereign. This system led to the enactment of laws by which the occupiers of land were forbidden to keep more than a certain quantity of sheep, and, on the other hand, a bounty was allowed upon the exportation of corn; these measures were absolutely necessary, for to such an extent was the cultivation of cereal crops abandoned, that the price of corn rose, and severe scarcity was almost the normal condition of the country.

The first treatise extant on agriculture or "husbandrie" was that of Sir Anthony Fitzherbert, published in 1518. This work combines, in a condensed form, all that was necessary to be practised on the farm, according to the system of fallowing at that time in fashion, and in the absence of those restorative crops the raising of which is the practice of the present age. Sir Anthony was a lawyer and a judge, but it seems by his work that he found time to practise "husbandrie" for forty years; and with a well-stored and well-regulated mind, he gives in a concise form his experience on all rural matters, from the

* An old song confirms this. It begins thus:—

"I had six oxen to my plough,
And pretty ones they were, and I wish I had them now," &c. &c.

† "A New System of Husbandry," by C. Varley, 1774.

preparation and sowing of the land to the breeding and tending of cattle and sheep, and even to the regulation of the domestic arrangements of the husbandman's family. A strain of unforced and unassuming piety prevails throughout the work, which, however ill placed it might be considered in a treatise of the kind of the present day, is nevertheless so well introduced as to produce a pleasing effect upon the reader. As a compendium of husbandry it is complete at all points, and in many respects may be still read with profit. The way in which he insists on the utility of keeping much cattle in order to produce much corn, shows that he fully understood the first principles of the art on which he wrote—so far, at least, as the absence of scientific knowledge admitted. He appears to have paid great attention to the nature and various qualities of soils, and the method of ameliorating them by intermixtures and the application of earthy or mineral manures. He also exercised his philosophic mind in investigating the laws of vegetation, and examined with attention the principles on which the Romans and other nations of antiquity conducted the operations of agriculture. His "Booke of Husbandrie" naturally attracted great attention at the time, and it is generally understood that its appearance formed a sort of crisis in the history of British agriculture, which from that time dates its revival. Whatever errors there may be discovered in it, they belonged to the times in which the author lived; and we may safely assume that had Fitzherbert lived in the present day, he would have been one of the first agriculturists of the age.

Sir Anthony Fitzherbert's work gave birth to several others. Sir Hugh Platt appears to have trodden in his steps and to have gone deeply into the subject of both agriculture and horticulture. His "Paradise of Flora" was the only one of his works published during his lifetime, and is a very ingenious performance. His treatise on manures displays a remarkable acquaintance with the fertilizing properties of different substances, and a knowledge of the importance of covering dunghills from the action of the sun and rain. His list of natural manures is almost as copious as ours of the present day, embracing salt, the sweepings of the streets of cities and towns, clay, fuller's earth, peat, stable and yard dung, all kinds of decomposed weeds, hair, vegetable ashes, maltdust, soap-lees, marl, urine, &c.

Gabriel Plattes lived and wrote on husbandry through the reign of Elizabeth and until the Commonwealth. His works possessed great merit, but he was ill rewarded, and died in London in the most abject poverty, without even a shirt to his back—so little was literature, at least agricultural, appreciated at that period. Yet some allowance must be made for the disturbed state of the kingdom during the latter part of his life, "when," as Hudibras expressed it,

"Civil dudgeon first grew high,
And men fell out they knew not why,
And hard words, jealousies, and fears,
Brought folks together by the ears."

In fact, the civil wars of the seventeenth century were as injurious for the time to agriculture as those of "the Roses;" and the precarious conditions of real property, whilst the balance of power between the two parties in the country was undecided, leading alternately to confiscations on both sides, was a bar to all improvement.

Two remarkable men appeared as writers in the seventeenth century—namely, Captain Walter Blith and Samuel Hartlib. The first of these wrote a book, in 1652, entitled "The English Improver Improved," and it contains as complete a system of irrigation and of drainage as could be written in the present day. One of the greatest obstacles to both these necessary operations he alleges to be the existence of water-mills, which, on the one hand, by damming up the rivers to the very brink, convert good land into bog; and on the other, by monopolising all the water of the river, deter, by threats of prosecution, those who have lands adjacent to the stream, from making use of it in irrigating those meadows or fields lying contiguous, that require or would be benefited by it. Thus we find, that two hundred years ago, the very plans which are now proposed as the basis of an act of parliament, and which have already been the subject of local acts for different districts, seem most intelligently insisted on, with the same view, by this clever writer. He proposed the passing of an act to destroy all the worst mills, and compel the owners of those which remained, to lower their mill-heads, so as to facilitate the proper drainage of the land; in other words, to carry out a system of arterial drainage similar to that which has been effected in Ireland with so much success and advantage. At the time when Captain Blith wrote his work, and for long after, the greater part of the land of England was in open fields, somewhat the same as it is in France at the present time. These fields were in the occupation of numerous persons, and were divided into slips, separated only by a baulk, and having one common road leading to them. It is evident that no stock can be kept by the occupiers of these lands; but as the road was a public one, the stock that was driven through it in travelling to fairs and markets, occasioned great mischief to the crops of corn. And besides this, the lord of the manor had the right of running his flock of sheep over it, after and during a certain time of the year, when the young wheats were above ground; these afforded a considerable quantity of feed on such occasions; but, at the same time, it was impossible for the owners of the land to farm it otherwise than on one common principle. This was generally a fallow, and a crop of corn, it being out of the question profitably to cultivate any kind of green crop on such lands. Blith saw the evil arising from this "entanglement" of lands, as he calls it, and one of his plans of improvement embraced a general enclosure act, such as was adopted a hundred and fifty years after.

Another of his plans of improvement was the discovering of simple materials on the lands around, and from manufactories, for making composts. What his ideas on this subject were, may be judged from the following passage:—"And in thy tillage are these special opportunities to improve it, by liming, marling, sanding, earthing, mudding, snail-codding (?), mucking, chalking, pigeon's dung, hen's dung, hog's dung, or by any other means, as some by rags, some by coarse wools, by pitch-marks, and tarry stuffs, any oily stuffs, salt, and many things more; yea, indeed, anything almost that hath any liquidness, foulness, saltness, or good moisture in it, is very naturally enrichment to almost any sort of land, all which, as to all sorts of land, they are of exceeding meliorating nature, and most of these more particularly." His catalogue of manures therefore embraced every kind of material that was capable of decomposition, and of such mineral or earthy substances as were calculated to disintegrate a heavy, or bind a light soil. Chemistry had not then opened up the treasures of the laboratory to the resources of agriculture; but so far as natural means of improving the soil are concerned, with the exception of the absence of bone-dust and guano in the list, Sir Walter Blith was as much upon a par with the system of manures of the present day, as he was in the ideas he entertained on the subject of drainage and enclosures; and that he was far in advance of his times, is equally clear from the slow and reluctant progress his propositions made amongst his cotemporaries.

Hartlib's book was published about the same time* as that of Captain Blith. Like this latter he declaims against the system of "common lands," and insists on the necessity of a General Enclosure Act, not only for those lands which were already under tillage, but for the waste lands—commons, moors, fens, heaths, marshes, &c., a large proportion of which have since been added to the arable and pasture land of the country. One of his plans for the improvement of agriculture excites surprise even in the present day, namely, the establishment of an agricultural college, for the education of youth in all branches of husbandry. An estimate of the expenses and produce of wheat culture in his work, will enable the reader to form an idea of the results of the system of husbandry then practised.

EXPENSE AND PROFIT OF CULTIVATING AN ACRE OF WHEAT.

	£	s.	d.
Rent	0	13	4
Dung, 24 loads at 1s. 3d.	1	10	0
Seed 9 pecks at 1s. 6d.	0	13	6
2 ploughings, sowing and harrowing.	0	10	0
Weeding 3s., fencing 3s. 4d.	0	6	4
Reaping	0	6	8
	£3	19	10
Deduct for next crop on account of manure	1	0	0
	2	19	10
Return 2, 2½, or 3 quarters per acre, but the less is the most usual, say 16 bushels at 5s.	4	0	0
Nett profit . .	£1	0	2

This account does not speak very highly for the system of agriculture of that day; but there were then many drawbacks upon the produce. One of these, of which Hartlib complains, was the number of pigeons kept at the old manor houses, each of which had one large dove-cote. He estimates that every pair of pigeons consumed as much corn as a man, or six bushels a year, and that there were as many pairs kept as there were inhabitants. To this and the immense number of rabbits' warrens, and the waste occasioned by the depredations of cattle in the common fields, may be ascribed a large diminution of the cereal produce.

Gabriel Plattes had the merit of inventing the first recorded model of a drill for sowing corn, and also one for laying up the land in ridges after the wheat is above the ground. His sowing or planting machine, for it was rather a dibbler than a drill, is a very complicated affair, and from its not getting into general use may be supposed to be not a very practical plan. He was, however, followed, fifty years after, by an inventor who, in an anonymous work (signing himself "J. W."†), has given a description of a drilling machine, with a sketch, for drilling one, two, or more rows of corn. This machine is certainly the parent of the present ones; for however rude and simple its construction may be compared with the modern ones, the principle on which it acts is the same, as may be seen by the annexed plate. Cobbett, in his republished work of

* It is dated 1651.

† We believe his name was Worledge, he being mentioned in Tull's work as having invented a drill which was never much in use.

Jethro Tull has given his author the credit of being the inventor of the drill machine;* but this work which we have now before us was printed in 1675, which was thirty years before Tull was engaged in agriculture. At the same time it is probable that Tull might, at first, not have read the work of J. W., or heard of his machine; and as he states that he took his ideas from the finger-board of an organ, and avows himself "the sole inventor" (p. 435), there is no reason to doubt his statement to that effect. He refers, however, in his "notes" (p. 421), to a drill invented by a Mr. Worledge (probably the identical J. W.), a cut of which was shown to him by Dryden, the poet; but this was after he had constructed his own, and he avows that he was not aware before of its existence. This is most likely to be true, because Dryden stated that Worledge's machine was never used. The drill of J. W. would put in either one, two, or more rows, which we believe was the same number as was performed by Tull's. It is certain that the latter was a more complete and complicated machine than the former, but both undoubtedly were on the same principle as the drills of the present day, although ruder in the construction.†

J. W. follows Blith in recommending irrigation and drainage, and goes more deeply into the subject, and gives sketches of two machines for raising water to the level of the fields or meadows. One of these is the Persian water-wheel; the other a windmill of very simple and inexpensive construction. He complains bitterly of the evil effects of water-mills, which, as he justly avers, destroy ten times the value of the profit they yield to their owners. His catalogue of manures is even more extensive than those of Blith and Hartlib, and he is the first agricultural writer who includes cattle bones and horn shavings amongst them. "All marrow-bones, fish bones, horn, or shavings of horn, or liquors wherein flesh or fish have lain, or anything whatsoever that hath any oiliness or fatness in it, is useful in husbandry. It were not much labour to try whether the bones of horses or other beasts, whereof there are great quantities at some dog-kennels, which, if burnt in heaps, with some small addition of fuel, would be of good effect to be laid on land."

In the absence of modern chemical knowledge, the dissertation in this work of J. W.'s on the principle of animal and vegetable life is curious. There are, according to his theory, three substances employed in the process—the spirit of mercury, the spirit of sulphur, and the universal salt. These act by being combined in "that universal spirit or vapour which daily and every moment perspires and proceeds out of every part of the earth, and is in everything, containing in itself the spirit or mercury, the sulphur, and the salt in one body united, and without art indivisible, yet some one part or principle abounding more or less in everything; as the water containeth more of the spiritual or aqueous part; several fruits, plants, flowers, and soils, more of the

* "It is evident that the author was the original inventor of drills in England, but his description of those he alludes to is purposely left out in the present edition, being superseded by the improvements of late years."—See Cobbett's edition of "Tull's Horse-hoeing Husbandry," note at p. 12.

† After giving the directions for making the machine, J. W. goes on as follows:—"One horse and one man may work this instrument, and sow land as fast, or faster, than six horses can plough, so that you may with ease compute the expense in case your instrument be single; but you may, in the same frame, have two shares at twelve inches distance, more or less, as you will have the rows of corn distant from each other, and two pipes out of the same hopper, and two small wheels on the same axis, with other wheels, answerable, every whit as easy to be performed as one, and then you may double your proportion of land in a day. This instrument will always keep the same proportion (of seed) you first set it to, which you must thus contrive: first know the length of the furrow you sow, then cast up how many of these furrows at such distance your instrument is made for (whether a foot more or less) will amount unto an acre, then conclude how much to sow on an acre; as suppose a bushel, then divide that bushel into so many parts as you have furrows or distances in that acre, then take one or two of those parts and put into your hopper."

sulphureous; and barks of trees, blood of animals, and several minerals, more of the saline." Here we have the remains of the ancient alchemy, which was like a blind man endeavouring to distinguish colours by the touch or the smell. Half a century afterwards Priestley unfolded the mysteries of the aeriform fluids; since then, further discoveries have from time to time been made in the laboratory, by which the true principles of vegetable life have been explained, so far, at least, as they are considered capable of it.

The next writer on agriculture, whose work demands more than a passing notice, is Jethro Tull, who at the beginning of the eighteenth century commenced an entirely new system of husbandry, founded on principles previously unknown, and the truth of which, even to the present day, is the subject of warm controversy, namely, that perfect tillage and pulverization of the soil will cause it to receive from the air sufficient nourishment or food for plants to produce crops equal to those obtained by manure with the ordinary tillage. Upon this principle he conducted his own farms of nearly 200 acres, for upwards of thirty years, with so much success that he was enabled to increase his income by letting one farm at above one-third more rent, after practising his own system only nine years, than it had ever before realized.

Tull had received a liberal and classical education, which brought him to be acquainted with the practice of husbandry by the ancients, especially the Romans. He had intended to pursue one of the learned professions, but an acute and incurable chronic disease (the stone) incapacitated him for practising at the bar, and compelled him to travel for his health. This was about the year 1712, and his active mind found ample employment when in the south of France and Italy in noticing the system of culture practised in the vineyards, from which he deduced three agricultural propositions, namely:—

"First,—That interculture amongst the growing crops is a necessary operation in well-conducted farming.

"Secondly,—That adequate tillage is not only an economical substitute for manure, but that—

"Thirdly,—Thorough tillage is also competent, with or without the aid of manure, to secure the profitable growth of any given species of cultivated plant year after year in succession."

This novel conclusion Tull arrived at by the following course of reasoning:—"The vines of low vineyards (*i.e.*, where the plants are kept by pruning in the condition of low shrubs), hoed by the plough, have their heads just above the ground, standing all in a most regular order, and are constantly ploughed in the proper seasons. These have no other assistance but by hoeing, because their heads and roots are so near together, that dung would spoil the taste of the wine they produce in hot countries.

"From these I took my vineyard scheme, observing that indifferent land produces an annual crop of grapes and wood without dung; and though there is annually carried off from an acre of vineyard as much in substance as is carried off in a crop of an acre of corn produced on land of equal goodness, yet the vineyard soil is never impoverished unless the hoeing culture be denied it; but a few annual crops of wheat, without dung, in the common management, will impoverish and emaciate the soil.

"I cannot find, either in theory or practice, any other good reason for this difference, except that the vineyard soil is more pulverized by hoeing.

"The soil of the vineyard can never have a true summer fallow, though it has much summer hoeing, for the vines live in it, and all over it, all the year; neither can that soil have benefit from dung; because although by increasing the pulverization it increases the crop, yet it spoils the taste of the wine. The exhaustion of that crop is, therefore, supplied by no artificial help but hoeing; and by all the experience I have had of it, the same cause will have the same effect upon a soil for the production of corn."

The reasoning in the above passage is complete and conclusive, and displays a mind well trained to thinking, and perfectly independent of all preconceived ideas. In his preface he thus apologises for going contrary to the usual routine :—"I beg pardon of the learned writers from whom if I am forced to differ in opinion as well as in learning, I assure them it is unwillingly and with regret that I do. No canon having limited what we shall think on agriculture, nor condemned any of its tenets for heresy, every man is thereon a freethinker, and must think according to the dictates of his own reason, whether he will or no; and such freedom is given now-a-days in speculations in natural philosophy, that it is common to see people, even in print, maintain that there are antipodes, that the earth moves round the sun, and that he doth not set in the sea, without being censured for these and many other formerly heterodox opinions; and any one may now, upon solid arguments, contradict Aristotle himself publicly, anywhere except in the schools. But that mine are such which I bring for maintaining the principles which I have advanced, I dare not affirm, being myself no competent judge of them, as the reader (especially the practising reader) is. To his decision must be left all that is disputable; his partiality I have no reason to apprehend," &c.

Like all innovators upon established routine, Tull had a host of enemies raised up against him, the most formidable of whom were a society of writers, who took care to remain *incognita,* but who, from their advocacy of the doctrine of "equivocal generation" of both plants and animals (which Tull humorously combats), he calls the "Equivocal Society," and "*Equivocus.*" However, in spite of opposition, he managed to grow wheat thirteen consecutive years, without impoverishing the land, and produced as large crops by sowing only half of it, without manure, as his neighbours did on the whole, with it. As we shall have occasion to refer to his system at greater length in a more advanced portion of this work, it is unnecessary at present to say more of it. That Tull was far in advance of his age there can be no doubt; or that the present race of agriculturists are indebted to him for many of the principles which are now recognised and established amongst them. Whatever errors he may have committed in his practice or writings, are to be ascribed rather to the imperfection of scientific knowledge than to a want of discernment on his part. His argument in favour of the circulation of the sap in plants, which was at that period a subject of controversy, and the truth of which the "Equivocal Society" disputed, shows the openness of his mind to conviction, and its acuteness in investigating a philosophical truth. "Since leaves," he says, "do so much resemble lungs in the anatomy of their organs, it is very reasonable to believe that they imitate them in their office; though the fineness of the vegetable vessels, and slow motion of the sap, will not admit a demonstration of the sap's circulation by ligature; but we have other reasons which do sufficiently prove it."*

* This proposition was advocated by the French philosophers, Perrault, Major, Mariotte, and Malpighi, and by the Englishman, Grew, in the last century, but was ably and demonstrably disproved by Dr. Stephen Hales, although opposed by almost the whole body of naturalists of the day. His experiments showed that the sap rises and descends in the same

That Tull's system of cultivation should not have been generally adopted at that period is no cause for surprise, although the triennial fallow was almost universally practised, and his system embraced the alternate fallowing of half the land yearly. As, however, he was the first agricultural writer who broke through the trammels of the established opinions of the day, and who expressed his own sentiments in the language of true science, his career, private and unassuming as it was, may be considered as constituting an era in the history of agriculture, from which may be dated many of the most important improvements, such as horse-hoeing, drilling, the perfect pulverization of the soil, &c. &c. These three operations alone stamp him with the character of a discoverer of no ordinary merit, and entitle him to a niche in the "temple of Ceres."

It is proper here to mention two important accessions to agriculture that had taken place during the seventeenth century, which in their results have effected a complete revolution in the system of husbandry of England. These are, first, the introduction of clover, sainfoin, and other artificial grasses or green crops; and secondly, that of the turnip as a field product. All these were brought originally from Holland and Flanders, and are mentioned by both Walter Blith and Hartlib. The former states, in his "Improver," that "in Brabant they kept four cows, winter and summer, on one acre of clover;" and that in England "four coach-horses, and more, have been kept all summer long on an acre." Hartlib is equally warm in his eulogy of it, and mentions a case in which "six acres of clover did maintain for half a year thirteen cows, ten oxen, three horses, and twenty-six swine, which was valued at £40, besides the winter herbage."

The turnip was first used in England for culinary purposes; but Hartlib, in his "Legacy," speaks of it as having begun to get into use in many parts of the country in field culture for cattle, sheep, and swine. J. W., who wrote twenty-five years after Hartlib and Blith, complains of the very great neglect and deficiency in English husbandry in not prosecuting more extensively the cultivation of turnips, seeing that "they supply the great want of fodder that is felt in winter, not only for fatting beasts, swine, &c., but also for our milch cows."

Sixty years later, Tull writes on the same subject as follows: "As far as I can be informed, it is but of late years that turnips have been introduced as an improvement in the field." It appears, however, that the method of cultivating them in his time was very different from what it was a few years after. They sowed them broadcast amongst wheat or barley a little after midsummer, and thinned them out after the crop of corn was harvested. Tull improved on this method, by drilling both the corn and the turnips—the latter between the wide intervals his system of husbandry allowed to the former; so that by this plan he obtained much superior crops to those of his neighbours. The idea, however, of substituting a green or a root crop for the bare fallow was not then entertained. Tull's system came nearest to this; and he certainly introduced the proper method of hoeing turnips, which he recommends to be set at the rate of thirty to the square perch, or about one foot to each root.

Thus, everything to which Tull directed his attention underwent an improvement at his hand. He was eminently a discoverer, and seemed to possess an intuitive perception

vessels, and, consequently, that there can be no circulation. This, however, does not detract from the merit or reputation of Tull, who died before the doctor had instituted the elaborate experiments by which he discovered the true theory of the sap. Dr. Hales died in 1761, at Teddington.

of what was fit and proper in whatever he undertook. He closely studied nature, and, so far as the want of analytical knowledge allowed him, he penetrated into her secrets. Where he failed it was for want of that knowledge, which would have enabled him to perceive that manure was valuable for other properties than that of a mere disintegrator of the soil, and that it really contains a superabundance of those elements of fertility—that "pabulum" of plants which he ascribed solely to the atmosphere through the medium of the triturated soil. It was no discredit to Tull that he did not know this truth; for it has only been brought to light after chemistry had for a century, or nearly so, been placed upon its proper foundation. Even Arthur Young, at a much later period, and after the discoveries of Priestley, and Franklyn, and others, denounced the idea of chemistry being applicable to agriculture. Enlightened as he was on almost all practical subjects, he was as completely in the dark on that of the laws of vegetable nutrition as Tull was himself. It was not, in fact, until De Candolle and others announced their discoveries of the laws of vegetable life, and Liebig had made his researches into the organic structure of plants, that any approach was made to the development of the mystery which Tull failed to perceive.

The publication of Tull's work made but little impression in England, where it might have been expected to produce the most. It is a remarkable fact, however, that three Frenchmen simultaneously, and without preconcert, or even knowledge of each other's intention, made a translation of it. His system was introduced into Scotland by Lord Belhaven in 1760, and a few years after, into Northumberland by a farmer of the name of Dawson, residing at Frogden, in that county. The latter found the agriculture of the district in the most barbarous state, and he was, like Tull, violently opposed and ridiculed by his neighbours at first; but when they saw that his crops were very greatly superior to their own, they gradually adopted his system.

We have now reached a period when agriculture underwent one of those beneficial changes which gradually enlisted into the ranks of its adherents a host of men of fortune and intelligence. The accession of George III. to the British crown imparted new life to the occupation of a husbandman. Whatever may be the opinions entertained of this high personage as a sovereign, every one will give him credit for being one of the first agriculturists of the day.* His farm at Windsor, which was overlooked by himself, and managed for many years by Mr. Kent, was a model of neatness and fertility. Here the king might frequently be seen at six o'clock in the morning, inspecting the sheep, or directing the workmen, with as little of state or ceremony, and dressed in as homely a garb, as a common farmer, for which he has frequently been mistaken. He was always back to the castle at eight o'clock, which was punctually his breakfast hour;† after which his time was devoted to state affairs.

* Even the cynical Lord Byron gives him credit for this virtue, if such it can be called. He says, in his parody of Southey :—

"A better farmer ne'er brushed dew from lawn;"

but he adds—

"A worse king never left a realm undone!"

† The following incident was related to the writer by a hairdresser, who lived at a shop at the corner of a lane by which the king frequently went and returned, as a "short cut" to and from the home park. On one morning the barber, being late, was opening his shop, and in turning the corner with a shutter in his hand, ran point blank against the king, and knocked him down. He was so astounded himself that he had no power to help his prostrate sovereign. Unhurt, however, the latter soon rose, and began rating the barber soundly—not for knocking him down, but for being so lazy as not to have his shop open before eight o'clock!

Amongst the many writers who followed Tull, on agricultural affairs, the most eminent was Arthur Young, whose advent upon the stage constituted an important period in our history. His first work was "The Farmer's Letters to the People of England," published in 1767, from which time he issued a series of the most valuable works containing instructions for the improvement of land. "He commenced his career," says a modern writer, "when a general spirit of inquiry had arisen amongst agriculturists and men of education. He began to interest them in it. Although he was in the background with regard to chemistry, which he repudiated, his career was one of great service to agriculture, and the practical farmer was indebted to him for laying the foundation of successful cultivation. The Board of Agriculture was established in 1793, and Sir John Sinclair was chosen its president, and Arthur Young, Esq., the secretary." Under his directions the agricultural surveys of every county in the kingdom were carried out—a most valuable and important undertaking even at the present time, although the proceedings of the Royal Agricultural Society of England have in a measure rendered them somewhat obsolete, so far as practical agriculture is concerned.

About the same time that Arthur Young made his *début* on the theatre of agriculture, another star of the first magnitude arose in the same constellation, if we may be allowed to use so high a metaphor. This was Thomas William Coke, Esq., the Holkham chieftain, who, from the period when he placed himself under the guidance of Young, never ceased his endeavours to raise the agriculture of his native country to the highest pinnacle of prosperity.

When Mr. Coke first went to Holkham as its proprietor, the grounds which now surround the mansion were a rabbit warren, stretching out towards the sea. The whole district was of so sterile and intractable a character, that the land let for 2*s*. an acre. After effecting some improvements, when the proprietor required an advance of a shilling or two of rent, the tenant abruptly threw up the farm, and Mr. Coke determined to take it into his own hands. It was an arduous, if not a hopeless task, to look forward to; but he was not the man to despair.* Under the guidance of Young, he commenced his career of improvement, and speedily converted the barren waste into a fruitful tract, producing the finest crops of grain of all kinds in the kingdom. About 2,000 acres of the most inferior land were planted with trees, which now constitute woods of valuable timber; and it is worthy of remark, that Mr. Coke (afterwards Earl of Leicester) lived long enough to build two ships at the neighbouring port of Wells entirely of oak from trees of his own planting. Many years too before he died, the thinnings of the plantations brought in several thousands a year.

The example and success of this noble proprietor stimulated others, and the whole county of Norfolk soon felt the benefit. The writer has heard old people say they remembered the time when "from Holt to Lynn," embracing a tract forty miles in extent, and comprehending Holkham and Fakenham in its sweep, "there was scarcely an acre of land thought strong enough to bear a crop of wheat." At present there is probably more wheat grown in, and exported from, that district than in any of the same

* The writer heard Mr. Coke relate the following anecdote in illustration of the desperate barrenness of the property. The lady who afterwards became mistress of the mansion was on a visit at the Marquis Townshend's, at Rainham Hall. The Ladies Townshend were bantering her upon the prospect of having to reside at such a barren wilderness. "I was once there," said one of the ladies, "and I never wish to go again, for I declare, that the whole time I stayed, I saw only one blade of grass, and there were two rabbits fighting for it."

extent in England. "A large part of the credit due to this wonderful transformation," says a late writer, "belongs to an extensive proprietor in the county, the friend and disciple of Arthur Young, Mr. Coke, who, in acknowledgment of his services to agriculture, was created Earl of Leicester. He died a few years ago, at an age not far short of a hundred. Mr. Coke had a large property in the west of the county, called Holkham, containing about 30,000 acres. This immense estate, which is now worth at least £1,200,000, was worth no more than £300,000 when Mr. Coke inherited it. It was then in the occupation of a great number of small farmers, who paid their rents very badly, although they were very low; and, ultimately, a great many of them abandoned their farms altogether, because they could not make a livelihood out of them. It was then that Mr. Coke decided upon farming a portion of these sandy wastes himself; the rest he put into very large farms; and by offering leases of twenty-one years, held out an inducement to farmers of intelligence and capital to take them. It is estimated that, in the course of fifty years, Mr. Coke expended £400,000 in improvements of all sorts, which caused the farmers to lay out as much more—an excellent investment on the part of both, since they have all made money by it."

"Any one who wishes to get an idea of this period in the history of English agriculture ought to visit Holkham. The farm, which Lord Leicester personally directed, lies in the park belonging to the mansion. Its extent is 1,800 acres, 500 of which are in permanent pasture; the rest is arable land, laid out exactly for the four-course rotation. The farm maintains 250 large cattle, 2,500 Southdown sheep, and 150 pigs. An equally profitable visit may be paid to Castle-acre, a farm of 1,500 acres, and several others in this district also deservingly famous. The whole of this land formerly grew only rye; now, it does not produce a particle of that grain, but instead are to be seen the finest wheat crops and the best cattle in the world. The present Earl of Leicester is a worthy representative of his father."*

Early in the reign of George III. another man of eminence in agriculture appeared upon the stage, whose experiments have added a mine of wealth to the country. This was the late Mr. Bakewell, of Dishley, in Leicestershire, who about the year 1760 began that course of experiments in the crossing and rearing the sheep of his native county, which terminated in introducing a new and beautiful race, which has, as is well known, by its precocity, added largely to the production of meat in the United Kingdom. Like other innovators, Mr. Bakewell was opposed by ridicule at first, as an enthusiast. He visited the Continent, and selected some of the best breeds he there met with, by which he obtained in a few years the object for which he sought—perfect symmetry of form, smallness of bone, and early maturity. In addition to this, the Dishley breed were remarkable for the heaviness of their fleeces, the fineness and length of staple of their wool, and the excellence of their flesh. Bakewell's success was far beyond his own expectation in a pecuniary point of view. So highly were his sheep appreciated by the flock-masters of England, that in 1789 he let three rams for the season for 1,200 guineas, and the whole produce of his letting that year was 3,000 guineas —one ram obtaining him 800 guineas, besides serving him for his own flock of ewes. Mr. Bakewell died a wealthy man in 1795. His improved breed of Leicester sheep was introduced into Northumberland by Mr. Culley, an eminent farmer and flock-master,

* "Rural Economy of England," by L. de Lavergne, p. 225.

who by strict attention to the rules adopted by Bakewell, was able to prepare his fat sheep for the butcher at little more than a year old. About the same time, Mr. Ellman, another enterprising flock-master, in Sussex, made similar improvements on the breed of Southdown sheep, which have since been a favourite race on all light-soil farms.

Taking the hint from these improvers in sheep, two brothers, of the names of Charles and Robert Collins, residing at Darlington, in the county of Durham, undertook the improvement in the breed of cattle of that county about the year 1775, and their success was quite equal to that of their prototype, Bakewell. The history and celebrity of the short-horned, or improved Durhams, is too well known to need a page in this work. It is sufficient to state that, on their retiring from business about the year 1810, the stock of Mr. Charles Collins sold for £7,115 17*s*., and that of his brother, Robert, for £7,858 4*s*.—a tangible proof of the high estimation in which the cattle were at that period held, and which they have ever since maintained amongst the herds of the United Kingdom.

The attention paid to agriculture by the sovereign, and the example and success of such men as Coke, the Duke of Bedford, the Earl of Yarborough, Sir John Sinclair, and many more eminent men who followed in their wake, produced a most beneficial change in the character of country gentlemen in general. A celebrated nobleman, writing on this subject, makes the following remarks:—"In former times hunting was the only business of a gentleman. The practice of blood made him rough and hard-hearted; he led the life of a dog, or of a savage—violently active in the field, supinely indolent at home. His train of ideas was confined to dogs, horses, hares, and foxes; not a rational idea entered the train, not a spark of patriotism—nothing done for the public—his dependents enslaved, and not fed—no husbandry, no embellishment—loathsome weeds round his dwelling, disorder and dirt within. Consider the present mode of living. How delightful the change, from the hunter to the farmer—from the destroyer of animals to the feeder of men! Our gentry who live in the country have become active and industrious. They embellish their fields, improve their lands, and give bread to thousands. Every new day promotes health and spirits; and every new day brings variety of enjoyments. They are happy at home, and wish happiness to all."*

This improvement in the character of the landowner was accompanied by a corresponding change in that of the tenant farmer. Through the means of agricultural societies which held meetings from time to time, at which all farmers were invited to attend, that isolation of position in which he was formerly found, gave way to a free intercourse with others of the same profession from all parts of the country. By the interchange of ideas on such occasions between men of intelligence, that opinionated

* Lord Kames' "Gentleman Farmer," p. 20. There is no doubt, however, that the zest for a country life requires a degree of moral training to fit us for its perfect enjoyment. The vivid pictures of rural felicity drawn by poets, ancient and modern, and the pleasures of "cultivating one's own field," are delightful to the imagination of the citizen who spends his life amidst the smoke and turmoil of civilization in a condensed state; but they are not always realized. Cowley, the poet, had but one object in view throughout life, and that was to spend the latter part of it in retirement on his own estate. He realized this, and what was the result? "The first night that I came hither I caught so great a cold, with a defluxion of rheum, as made me keep my chamber ten days; and two after, had such a bruise on my ribs, with a fall, that I am yet unable to move or turn myself in my bed. This is my personal fortune here to begin with. And besides, I can get no money from my tenants, and have my meadows eaten up every night by cattle put in by my neighbours. What this signifies, or may come to in time, God knows; if it be ominous, it can end in nothing less than hanging!"—See Johnson's "Life of Cowley."

adherence to local practice and contempt of all innovations, which was the result of his former seclusion, yielded to a desire for improvements, and for investigating the plans of others who proposed them. An agricultural literature adapted to the times sprung up calculated still further to ameliorate and humanise the character of the husbandman, who in former times had repudiated "book-farming" as the height of folly bordering on insanity. To crown all, physical science, in all its integrity and truth, allied itself to agriculture, and in the end completed that course of instruction which had begun under such favourable auspices.

In point of fact, the physical sciences are all concentred in the word agriculture, which is in itself the body of which each of the sciences is a member or a part. The more this idea is entertained by the agriculturist, and the more he studies to make himself familiar with its bearing upon his practical life, the greater and the more successful will be the results. For, after all, it is the intimate connection of science with the every-day business and necessities of life, its ultimate bearing upon the wants and the well-being of man, that gives it its practical and social value. However desirable it is to study science for its own sake, as an enlarger of the mind calculated to advance it in the knowledge of transcendent truths, and leading the contemplation "from nature up to nature's God," to the masses of mankind, who have not the time or the means of pursuing abstract and metaphysical inquiries, and whose whole lives are spent in procuring the means of existence, the fact that science discovers to us the way by which "two ears of wheat can be grown where only one grew before" is the result which imparts to it real utility. The man of reading and reflection finds in the researches of science a fund of amusement and instruction, affording in their development an insight into the history of the works of creation and providence, which without them would be a painful mystery; but to the practical man there is superadded the stimulus of a personal benefit to be derived from the study of science; and the more intimately he makes himself acquainted with the nature of the materials with, or upon, which he has to operate, the more successful will be his career.

The institution of the Board of Agriculture in 1793 took place through the efforts of Sir John Sinclair, who obtained from parliament an annual grant of money, usually to the amount of £3,000. The idea of a "board" was first started by Lord Kames, in his "Gentleman Farmer;" but he proposed it for Scotland, where, at an earlier time (1784), the Highland and Agricultural Society was established with so much success. The "Board of Agriculture" undertook an agricultural survey of every county in the kingdom, which was completed in little more than one year; all the county reports were afterwards condensed into one general report, first of Scotland, and subsequently of England. Papers of great value on all agricultural subjects were published by the board from time to time, which, by obtaining extensive circulation, spread the spirit of inquiry throughout the country.

Another institution of a local and private character, but perhaps more conducive to the improvement of agriculture than even the "board," was established about this time. We refer to the "sheepshearings," as they were termed, held at Holkham Hall, the seat of Thomas William Coke, Esq., and also at Woburn Abbey, the seat of the Duke of Bedford, who had united heart and soul with Mr. Coke in his efforts to advance the interests of agriculture. The meetings at Woburn Abbey were discontinued in 1801, upon the death of the noble proprietor, Francis Duke of Bedford, who was succeeded on the estate by his brother, being himself a bachelor. The Holkham meetings were continued until the year 1821, when the advanced age of the proprietor of the Holkham estate compelled him to seek that repose in retirement, with which a continuance of the show and its accompanying labour and arrangements were incompatible.

This annual festival will for ever claim a page in the history of British agriculture. Although in its origin, arrangement, and entire pecuniary support and maintenance it was strictly a private institution, yet the unbounded public spirit and liberality of its founder gave it a world-wide fame, and drew to its exhibitions men of eminence in every branch of industry, and every station of life, from all parts of the globe;—agriculturists, men of science, statesmen, philosophers, merchants, mechanics, manufacturers, &c., &c., were indiscriminately invited to repair to the noble domain at the appointed time (generally the beginning of June), where for three days they were entertained, not only by the display of an assemblage of the finest animals the world could produce but on each day the hall was thrown open to 500 or 600 guests, who were specially invited upon a simple introduction from some person known to the proprietor.

Every new invention or improvement in agriculture, whether in machinery or in cultivation, here met with that attention and scrutiny which the efforts of genius and industry, or the results of experiment, should ever claim. Trials were made of new implements, and prizes awarded for those possessing extraordinary merit. Breeders of cattle and sheep were invited to exhibit their peculiar products, by which a spirit of emulation was excited, the influence of which will be felt upon the national agriculture to the remotest ages. Many of the most eminent of the exhibitors of cattle and sheep of the present day, are the sons or grandsons of those who sixty years ago made their *début* as breeders of improved stock at the Holkham sheepshearings.

At the dinner given at the close of each day the subjects that had occupied the attention of the company in the morning were freely discussed. Here men of rank and eminence, from all parts of the world, exchanged information on the different systems of husbandry practised in different countries and climates. Men of science here began publicly to apply its principles to the practice of husbandry, and to bring home to the mind of the cultivator the importance of a knowledge of the nature of the soil, and of the products that are raised from it. On the other hand, the practical farmer was invited and encouraged, in his own homely language, to express his thoughts and opinions on the different subjects brought forward. Spirited discussions between men of opposite views were frequently entertained, and by this collision of mind with mind, and of experience with experience, men of judgment were enabled to form their own conclusions and regulate their practice.

More than one generation has passed away since these once celebrated festivals were held, and there are few now living who attended them. Those who enjoyed that good fortune will not only to the latest period of life look back upon them with pleasure and satisfaction, but will be able to trace to them the career which has led to the present unprecedented state of our agricultural prosperity. It was there that the embryo Davys and Liebigs first met with that countenance and encouragement which inaugurated the union of practical science with agriculture,* and eventually brought forth those systems

* One of the first of these was W. Grisenthwaite, a practical chemist of the neighbouring seaport of Wells, who, in 1819, wrote and published a small volume "On the Theory of Agriculture, and the Nature of Soils, Crops, and Manure." This work he dedicated to Mr. Coke, who had taken him by the hand and afforded him every encouragement.

of agricultural chemistry on which the present practice of cultivation is based. All honour to the memory of the MAN (in the largest sense of the word) who, more than any one else, assisted in breaking down the barriers which ignorance and prejudice had reared between the cultivator and the man of science, and who prepared the way for that union between them cemented by principles indestructible because founded upon truth.

The war which commenced at the latter end of the last century, and continued to rage for upwards of twenty years, while it threw back the agriculture of the continental nations, produced an opposite effect on that of England. Whatever part our government may have taken in the contest, as the mainspring of the movement against France, the ravages of war, so destructive of all industry, were not permitted to reach the British soil. The insulated position of England, whilst it rendered a large maritime population a social and commercial necessity, gave her by that very circumstance a naval superiority which effectually protected her shores from the invasion of an enemy. While, therefore, the countries of continental Europe were alternately the seat of a devastating and vindictive warfare, which destroyed the fruits, prevented the industry of the husbandman, and drained the rural districts of the very sinews of labour, leaving only the old and infirm men, and the women, to cultivate the soil, England remained at perfect peace within her sea-girt shores, and pursued without molestation those schemes of agricultural improvements which in their progress and completion are the admiration of foreigners.

One of the most important of those improvements was the general adoption by the light-land farmers of Norfolk and Suffolk of the four-shift course of husbandry, by which the sandy and gravelly soils of those counties were raised in value from 5*s.* to 25*s.* per acre.* It was to the intelligent instructions of Arthur Young that this celebrated system owes its rise, previous to which the triennial fallow was almost universal. It is to this change of system that the success of the light-land farmers must be ascribed, for by it they are enabled to keep many cattle and sheep, which is the foundation of good culture. The success attending it led to its adoption throughout the country, and everywhere with similar results. Lands that formerly produced no more valuable crops than rye, or, at best, a scanty crop of sixteen or twenty bushels of wheat, will now, under the four-shift husbandry and high culture, yield from four to six quarters per acre of wheat, and corresponding crops of other produce. Thus, whilst the actual area of the soil employed in raising cereal produce is much smaller than formerly, the aggregate produce is greater.

A valuable addition to the compensating substances in the shape of manure came into use about the beginning of the present century. This was bone-dust, which has since obtained an extensive application, and has added greatly to the fertility of the soil. At first bones were reduced to small pieces with heavy hammers or mallets, or they were calcined into charcoal, being used in the former case for arable, and in the latter for pasture land. The success which attended their application to turnip land, and the desirableness of a better method of reducing them to powder, soon suggested the idea of machinery, and at the same time rendered the collection and sale of bones an object of considerable mercantile speculation. The value of bones as a manure will form the subject of a paragraph when we are treating of manures in general. As a proof of their importance to agriculture we may state, on the authority of Sir Robert Kane, that "1 lb. of bones contains as much phosphoric acid as belongs to 28 lbs. of wheat, or of

* This great improvement in light-land farming, however, had commenced some years before the war broke out, but was not generally practised previous to that event.

250 lbs. of potatoes; that this phosphoric acid is indispensable to the healthy growth of the plants, and of the animals by which they are consumed; and that hence will appear the vital importance to agriculture of preserving as far as possible these valuable materials, and returning them to the soil."*

The use of bones and oil-cake in the cultivation of cereal and other crops may be considered the first step in the application of condensed manures, which has lately made such rapid progress, especially since the introduction of guano. This has opened the eyes of the farmers more than any other circumstance to the value of chemical knowledge in agriculture. Up to the commencement of the present century all the ideas of the farmers in general, on the subject of manure, were confined to the farm-yard production of it, and few could comprehend how the food of plants—the elements of fertility—could be so reduced in bulk as that one hundredweight of any given substance should possess the virtue or strength of many tons of their favourite compost.† Bulk was their test of utility, and their motto "Muck's the man after all." The labour and expense of carting the farm-yard dung on to the land was not taken into account, because they had been accustomed to it, and the means and appliances for it were always at hand. Yet the reduced bulk of the home-made manure, by fermentation,‡ might have taught them that it was possible a still greater condensation could be effected without in any respect diminishing the intrinsic value of the residue. It required nearly half a century to instil this truth into the mind of the husbandman; and even when guano was introduced, and its wonderful effects were seen, it was difficult to make him understand that *that* substance contained no other elements of fertility than their own farm-yard manure, only in a much larger proportion, and with a smaller amount of the less valuable materials.

The drill husbandry, which was inaugurated by Tull at the beginning of the last century, was by no means generally adopted until after the commencement of the present. Dr. Andrew Hunter, in his "Georgical Essays" (published in 1772), has given a paper upon it, in which he says, "From the experience that I have had of the drill-sowing, I can recommend it as a most rational and judicious practice; but as it has many difficulties to overcome, I apprehend it will never be brought into general use. A proper instrument is wanting that would come cheap to the farmer, and have the requisite strength and simplicity to recommend it. The present instruments cannot by any means be put into the hands of common servants. Should we ever be so happy as to see this objection removed, it is probable that all kinds of grain will be cultivated in drills." § At the close of the essay he says, "Mr. Benson, of Stainly, near Ripon, *is the only farmer* that I know of who conducts his farm in this economical and judicious manner." ‖ So long was it before one of the greatest and most palpably economical and useful improvements made any way in field culture.

* Kane's "Industrial Resources of Ireland," p. 271.

† One hundredweight of guano is equal in volume to five tons of farm yard manure.

‡ It is true that in the usual method of promoting this process in farm-yard manure, by removing it to dung-heaps and submitting it to frequent turnings, and finally allowing it to lay spread over the field, a large porportion of the ammonia is lost by evaporation. This may be avoided by covering the heaps thickly with earth, so as to confine the combustion, and thus allowing it to consume the dung into a kind of charcoal; a coating of salt may also be applied, which would attract and fix the ammonia, converting itself into *sal-ammoniac*, the value of which is well-known in the present day in artificial manures.

§ "Georgical Essays," vol. iii. p. 124.

‖ Ibid., p. 129.

The use of the threshing machine, worked by horse power, was another improvement of the present century, at the commencement of which the flail was universally used. The loss of grain through the carelessness, or the cupidity of the "tasker," who was generally paid by the quarter, and therefore had an interest in threshing out the head corn, whilst that which was more difficult to separate was thrown out, can scarcely be calculated. It has been variously estimated at from five to ten per cent. Even at the lowest calculation the waste was considerable; for although it is said that the pigs and fowls reaped the benefit of the loss, it is plain that the proportion these animals could collect in a yard in which the straw was trodden down by cattle would be very small; whilst, in turning over a dunghill, the removal of every layer disclosed the waste in the number of grains uncovered. The improvements made of late years by the invention of combined machines, by which all the operations of the "tasker," from threshing the corn to putting it up perfectly clean into sacks, is a complete triumph of mechanical genius, leaving nothing further to be desired in the process.

The progress of agriculture during the war was rapid and successful. The high price of all kinds of produce, and the encouragement given to the landed interest in consequence of the impossibility of obtaining supplies from abroad in a scarce season, added to the difficulty attending mercantile and manufacturing operations, caused large capitals to be invested in the purchase and cultivation of land, and men of intelligence and enterprise embarked in it. Farming was no longer looked upon as a low and mean pursuit on account of the uneducated class who once practised it. That class had succumbed to the times, which were unfavourable to the success, or even existence of small farmers. The heavy taxation upon the land fell with crushing weight upon the small occupiers, whose poverty prevented them from cultivating their land to the best advantage at any time, so that their produce now was utterly inadequate to the incessant demands made upon them by the tax-gatherers, local as well as national. They were reduced to the condition of labourers, and their farms added to the large ones in the vicinity. These were from time to time further increased by the enclosure of the waste lands, by which hundreds of thousands of acres were brought under the plough, and rendered productive of cereal and other crops. Much of the land thus reclaimed under the stimulus of high prices, never paid the expenses, and some tracts have ruined successively every occupier who entered upon them; but, upon the whole, the General Enclosure Act has proved of great benefit to the country at large, as well as to the landed proprietors to whom the land accrued. The rapid increase of the population since the peace has been such, that even the addition of the waste lands to the cultivated portion has been insufficient to supply the demand, although the produce, also, has been increased to the extent of many bushels per acre, in consequence of the higher state of cultivation of the soil.

The peace of 1815, and, still more, the "Currency Bill" of Sir Robert Peel in 1819, which required the Bank of England to pay in cash after the 1st of May, 1823, produced a revulsion in the value of landed property that proved ruinous to thousands who had invested large capitals in it, a considerable proportion of which was borrowed on mortgage. Such was the immediate reduction in the value of land and its produce, that whilst thousands of farmers were ruined at once, many of the proprietors were compelled to sell their estates, which in numerous cases did not bring enough to pay the mortgagee. This was the case with some who, having inherited unencumbered property, had added to it by the purchase of adjoining estates, to pay for which they had borrowed money on mortgage of both the old and the new property, which on sale were alike sacrificed, the whole not producing more than enough to pay off the encumbrances.

It may be supposed that under such circumstances but little progress could be made, for the time, in the improvement of agriculture. The panic of 1825, and the failure of the banks throughout the country, added largely to the distress and disaster, and a vast number of the farmers in every part of the kingdom became so impoverished by their past losses, and so hopeless of the future, that they realized what little they could from the wreck of their property, and emigrated to Canada or the United States, where they found a better field of enterprise for their industry; at the same time the competition for farms at home was thereby reduced in an equal proportion.

It is not, however, in the nature of an Englishman long to sit down in despair, and brood over misfortune. Gradually a more healthy condition of things returned, and the spirit of enterprise and improvement was awakened again. Agricultural chemistry had been familiarised by the essays and experiments of Sir Humphrey Davy in England, and Boussingault, Payen, and other eminent chemists, in France and Prussia. The farmers themselves, generally speaking, were a different class to those of the last century, being mostly educated and capable of appreciating the importance of scientific knowledge. Many had so far made themselves acquainted with chemistry as to conduct an analysis with accuracy, whilst an agricultural periodical literature helped to diffuse valuable information on all subjects connected with the cultivation of the soil.

The Board of Agriculture had been dissolved in 1819, but almost immediately after, the Smithfield Farmers' Club had been instituted, and has had a most beneficial influence over the agriculture of the country in disseminating improved breeds of stock, new and improved machines and implements of husbandry, and in stimulating the farmers to engage in that enlightened progress which distinguishes the British agriculturists of the present age. One great aim of the leaders in this advance is the substitution of mechanical for animal power in the operations of husbandry, and in the prosecution of this enterprise much has been effected. Thus the threshing machine which in the first instance—introduced by Meikle*—only superseded the flail in the hand of man by the machine worked by horses, was very soon after placed under the power of steam; and from a simple threshing machine now combines, as we have stated, all the operations necessary to the perfect preparation of the grain for market, even to putting it into sacks. On a modern farm, too, the buildings are now so arranged that the various operations of the homestead are performed by a steam-engine, which not only threshes and prepares the grain for market, but also grinds the corn for cattle, cuts the hay, straw, and roots, saws timber, and, in fact assumes the same multifarious agency we see employed in the manufacture of cotton or wool.

Nor has steam power been confined in its exercise to the operations of the homestead; of late it has been applied in the field to the cultivation of the soil, drainage, and other work. As, however, we shall have occasion to go into this subject at length, when

* Meikle, however, was not the man who first invented the threshing machine. A Mr. Menzies, of Culterallers, in Clydesdale, invented one about the year 1740; it was worked by either horse or water power, gave 1340 strokes per minute, and with the attendance of one man would do the work of six flails. Meikle was a miller, at Houston, near Haddington, and a machine was sent to him by Sir F. Kinloch, of Gilmerton, Bart., to be put to work by water, but it was invented by Mr. Ilderton, of Alnwick, in 1775. It was twice torn to pieces, and *then* Meikle, who was also an engineer, effected an improvement in it, which succeeded. This improved machine was the parent of those now in use. Like many inventors and improvers, Meikle reaped no benefit from his ingenuity.

describing the various systems of steam ploughing that have been introduced, we shall only now observe that we are at present but on the threshold of steam culture; and that it cannot stop until the steam-engine has entirely superseded, not only the application of horse power, but adapted itself to the performance of all the most onerous parts of labour now devolving upon the hand of man. That this will eventually be effected, we cannot doubt; but it will require such an outlay of money, and such an entire remodelling of the land, in order to adapt it to the altered conditions of husbandry the system will involve, that it will probably be many years before the public mind can be brought to entertain the idea that the mission of steam in agriculture, as well as in manufacture and the conveyance of travellers and merchandise, will not be fulfilled until it has banished its rival, animal power, from the farm, and reigns alone.

The year 1838 may be considered an important era in the history of British agriculture. In that year the Royal Agricultural Society of England was instituted under the auspices of the Prince Consort, who has shown his desire to promote the interests of agriculture by the frank and hearty manner in which he has given his adherence to every movement for that object. The society has been of infinite service, and has, by its general proceedings, as well as its annual meetings, done more to improve the British farmer, and to render the land productive, than all the previous institutions of the like nature. Just about the time of its inauguration, the introduction of guano into the United Kingdom took place, and has completely modified the ideas of the husbandman on the subject of manures, by proving that all the most important elements of vegetable nutrition may be so condensed, as to supersede the labour involved in the preparation and distribution of farm-yard dung.

The Royal Agricultural Society was incorporated by royal charter soon after its institution. Its list of members comprises the most influential persons in the kingdom, especially those who have made agriculture in all its branches their study. Its proceedings are published half yearly, and its annual show, which is migratory, has done more for the improvement and invention of implements, and the application of machinery to the processes of agriculture, than any institution in the world. The multiplication of machines, as exhibited at these shows, is truly wonderful, and speaks louder of the wealth and intelligence of the British farmer than even the condition of the fields, although these are the astonishment of foreigners. The motto of the society, "Practice, with Science," is a fair representation of the objects of its institution. Under its influence the agriculture of England is rapidly becoming a series of scientific operations, in which the laws by which vegetation is governed, and the relative powers and affinities of the three grand elements of production—*soil, seed,* and *manure*—are better understood, and more systematically adapted to each other.

SECTION II.

HISTORY OF SCOTTISH AGRICULTURE.

We have already referred to the ancient tenure of land in Scotland, where the patriarchal was blended with the feudal system, and under which the country was divided into baronies of large extent, held by chieftains residing in strong castles. Their estates were managed by a chamberlain, and were subdivided into mark lands, which were cultivated by the retainers, who were tenants-at-will nominally; but the disturbed state of the country, and the dependence of the chieftain upon his clansmen for the support of his rights, real or assumed, were such, that he neither dare remove or punish them for their evil practices, as well upon his own as on the neighbouring estates. The timber was cut down, not only for purposes of building, but for the bark,—for every one tanned his own leather,—the wood being left to perish on the spot. The cultivation of the land was conducted in a desultory manner by the retainers. In Marshall's time this system was in full strength, and the soil was subdivided so as to give room for the greatest number of occupiers, and was thus frittered to atoms, and the estates burdened with a load of tenantry, considered justly a bar to all improvement, or good management.

The larger estates in the Highlands were divided into *officiaries*, each of which constituted a barony, containing from one to three square miles of valley land, with its proportion of hill, comprising from ten to twenty towns or farms, which were subdivided into six or eight farmlets. In some instances the farms remained entire. Each *officiary* had its ground-officer, or bailiff, who not only attended to the distribution of orders from the lord or his factor to the tenants, but overlooked the performance of the services, the roads to be kept in repair, the removal of tenants, &c. &c. The *birleymen* were sworn appraisers, or valuers, who settled disputes between landlord and tenant, or between the tenants, &c. The tenancy-at-will was the prevailing custom; but if a lease, or *tack*, was granted, it was for nineteen years. This term is still the favourite one in Scotland, but for what reason that particular number of years is preferred it is difficult to imagine.

With the exception of the modern sheep-farms, the holdings were invariably the same in character throughout the Highlands. Not the large farms only, but each subdivision, though ever so minute, and whether cultivated by *plough-gait*, *half-plough*, or *horse-gang*, had its pittance of hill and vale, and its share of each description of land—as arable, meadow, pasture, and muir. The valleys were separated from the hills by a stone wall, called the head dyke, running along the *brae*, or slope, and generally on the upper side of it. The lands were divided, as in the English old manorial system, into in-field and out-field. The manure was reserved for the former, and the cattle were folded on the latter—the only mode in which it gained any manure.

The minute subdivision of the land, which was carried to quite as great an extent in Scotland as it was, up to 1847, in Ireland, was productive of similar evils, not the least of which was the continual presence of scarcity at the close of almost every season, and more especially upon a failure of the crops, in which case it sometimes amounted to famine. In one instance it lasted seven years in the extreme remote parts of the north. Marshall's account, too, of the dwellings of the farmers affords a very low estimate of the domestic comfort they enjoyed. "The farmhouses," he says, "are built of stone without cement; but the crevices are stopped with loam, to prevent the wind from blowing through the walls, which are six feet high, and without glass in the windows. The doorways are so low that an ordinary man must stoop to go in. The same with the barn. The roof is set on with couples, or large principal rafters, stepped in the wall two or three feet above the foundation, generally upon large stones, set to receive their feet. Upon these couples lines of pantrees, or purlines, are fixed; and, resting on these, rough boughs, stripped of their leaves and smaller twigs, are laid rafterwise, and termed *cobbers*. Upon these, 'divot,' or thin turfs, are laid on in the form of slates, and upon this sod covering, a coat of thatch, composed of straw, rushes, heather, or fern—the latter being drawn up by the roots or cut close to the ground in the month of October, and laid on with the roots outwards, making admirable thatch. The gables and ridge are loaded with '*feal*,' thick sods, taken from the deepest and best soil."

The impossibility of effecting any improvement in agriculture under the system which prevailed, led the chieftains, or land proprietors, to convert the Highlands into sheep-farms of large extent, whilst the valleys only were cultivated. This change, which rendered necessary the removal of a great number of the small occupiers, and the entire rearrangement of the estates, met with much opposition from the crofters or small occupiers, who were turned out of their holdings, and compelled to emigrate. There was undoubtedly much hardship inflicted upon these poor people, although the miserable state in which they previously existed might have led them to consider the change beneficial. The most important, because the largest, of the rearrangements of Highland property was that of the Countess of Sutherland's estate, consisting of 800,000 acres, and a population of about 15,000 men, women, and children.

The countess, who was the last of her race, had made many fruitless attempts to introduce improvements upon her property; but she found the people inveterately wedded to their ancient customs and habits, and so ignorant as to prefer the miserable poverty and wretchedness in which they existed, and which frequently amounted to the extreme of want, to any alteration in their mode of living. She therefore determined to exercise her rights as suzeraine of the property, and effect by force those changes that the case required. In this she was powerfully seconded by her husband, the Marquis of Stafford, whose wealth enabled him to expend immense sums in carrying out the plans of Mr. Loch, the factor of the countess. As the leases fell in, the holders were dispossessed and removed to other parts of the estate on the coast, where the soil was of a better staple, and where the people might also apply themselves to the fishery, there being abundance of fish on the coast. The operation took ten or fifteen years to complete, but when fully carried out, proved entirely successful. A great outcry was raised against the countess and her husband, who were accused of the most barbarous cruelty to the tenants on the property. An investigation, however, showed so plainly that the charges were false, that the marquis was created Duke of Sutherland as a reward for the patriotism and humanity he had exercised in carrying out the alterations, and the large sums he had expended in the enterprise.

The improvement of agriculture in Scotland, however, dates back to 1760, when the farms began to be enlarged, and to be let on long leases. The system of husbandry also in that country was altered, and root crops were introduced. So early as 1764, Mr.

Dawson, of Frogden, in Roxburghshire, had 100 acres of turnips drilled on his farm. This was perhaps as large a quantity as could have been found at that time on any English farm of the same size. The formation of roads into every part of Scotland, where previously there was no access to many of the remote districts, contributed largely to improvements in agriculture. Previously it was impossible to use wheel carriages, and produce of all kinds was fetched from the fields on horses, or on the heads of women. The lands were also enclosed by hedges and ditches, or by stone dykes, which not only rendered the keeping of cattle from the crops easy, but by draining off the surface moisture, the land was rendered more productive, and the country generally more healthy. The use of lime began to be introduced, which greatly increased the produce.

In 1770 an act was passed to modify the law of entails in Scotland, which gave the landlords power to grant leases and improve their estates. The swing plough was introduced about this period, as also the Swedish turnip and the potato oat, which latter was accidentally discovered in 1788, and has proved a source of great wealth to the Scottish farmer. But the most rapid improvement of agriculture in Scotland took place after the breaking out of the war with France, when produce of all kinds took an enormous advance, and gave a stimulus to cultivation which has never subsided, but has raised the agriculture of Scotland to the highest pitch. The almost universal practice of granting long leases enables the occupiers of land to obtain advances from the bankers, and thus to carry out plans of permanent improvement at the commencement of their leases, especially draining, which, if the land requires it, is generally done upon the principles laid down by Smith of Deanston, or that of Elkington, both of which have helped to change the face of the country and the character of the climate. Previous to their introduction, all the lowlands were so clogged with water and intersected with bogs and swamps, that fever and ague were the constant attendants upon the rural population. Elkington's plan was applicable only to the removal of isolated springs, which left the retentive soils still subject to the deleterious influence of the water retained by them. Smith's plan drained large areas by sinking parallel drains in the direction of the fall, and at equal distances, greater or less according to the nature of the soil. It is estimated that during the last twenty-five years not less than 1,500,000 acres have been thus drained, and that a sum amounting to not less than £9,000,000 sterling, or £5 10*s.* per acre, has been expended in this work alone in Scotland, and that it has given a profit of from 15 to 25 per cent. upon that outlay.

The Highland Society has largely contributed to the spread of improvement in that country, both by its quarterly publications, and its attention to practical husbandry. Its premiums for discoveries in every branch of agriculture, but especially in the chemical department, which is now a regular portion of its functions, have elicited a body of information and experimental science of the most useful kind. The subject of chemical manures has been a special object of its attention, and perhaps not even in England is so great a proportion used as by the farmers in Scotland.

The size of the farms in Scotland varies from fifty to 1,000 acres, there being very few below the former, or above the latter, extent. It is, however, a subject of complaint that the system of extreme large farming is gradually becoming more common, and that the landowners prefer having one tenant with many farms, and large capital to stock them, than several with moderate sized farms and limited means at their disposal. This system undoubtedly is much less troublesome to the landlord, and probably the produce is greater; but it is, at the same time, injurious to society at large by reducing the amount of employment, and by depriving industrious young men of the means of getting into business. We hear of farms of 2,000 acres and upwards of cultivated land.

We have already referred to the banking system of Scotland as having materially contributed to the prosperity of the country. There are, in all, eighteen banks, having their branches all over the country, whilst their head offices are in the principal towns. The number of branch banks is reckoned at about four hundred, or one to every six thousand of the population. All the banks issue notes payable in specie at sight—which might appear a dangerous system in a country possessing a metallic currency of not more than half a million sterling. But such is the confidence of the public, that notes are preferred to cash in either large or small transactions, and a "run" upon a bank is a thing of very rare occurrence in Scotland. Such, in fact, is the stringency of the system in respect to the notes—which the bankers are obliged to exchange with each other *twice a-week*—that no excess of issue can possibly take place.

All the banks receive deposits of sums above £10, for which they pay $2\frac{1}{2}$ or 3 per cent. interest. This facility is made largely available by the servants and labourers, who have most of them their "banking account," where they deposit their savings, until they have enough to place themselves in business. The deposits, too, are employed by the banks in loans to any respectable persons who can bring two valid sureties for the repayment. The general prudence and economy of the Scottish people render these loans perfectly safe. The securities look after the borrower, who is himself anxious to discharge the debt as soon as possible, so that very few losses are sustained by the lenders.

It is by this excellent system that both agriculture and manufactures have made such rapid progress in Scotland, money never being refused where the conditions of the borrower are satisfactory. The former poverty of Scotland has been rather an advantage to her than otherwise, for it has taught her people the value of money, which is far better understood there than in England or Ireland, its scarcity in former times having superinduced a cool and calculating disposition, exceedingly favourable to a judicious application of the means at disposal, and their power or sufficiency to produce a given result; from which, when a Scotchman has formed his conclusions, it would be a very difficult matter to induce him to depart.

The Lothians, East, West, and Mid, which surround Edinburgh, are considered the most highly cultivated part of Scotland. They contain about 1,200,000 acres, which let at from 30*s*. to £5 per acre, excepting meadow land near the capital, some of which let as high as £30 per acre. These are irrigated with the liquid manure of the sewage, and are, in some years, cut six times, producing each time abundance of grass, and bringing the tenant a return of £40 a year. The wheat grown in the Lothians is of a first-rate quality. One hundred and thirty years ago, a field of wheat of eight acres, about a mile from Edinburgh, was an object of universal curiosity and wonder, the land being considered incapable of bearing anything more valuable than rye.

The Lothians include the counties of Haddington, Edinburgh, and Linlithgow, with the low tract of land along the coast between Berwick and Dundee north and south of the Firth of Forth, and the Carse of Gowrie. The district of Galloway is on the west of this area, and is famous for its breed of polled black cattle, of which large numbers are brought over to the eastern counties of England in the autumn, to be fattened. But since the railways have been established, and root crops have taken the place of fallows, a great number are fattened in the Lothians and sent to the English markets. They are a small breed, but fatten quickly, and their meat is excellent. The farmers, however, are getting more and more to prefer the short-horned cattle, which, though of an inferior quality of meat, attain to a larger size in a given time, and pay better. Galloway includes the counties of Wigtoun, and Kirkcudbright, and part of Ayr and Dumfries. Like that of Cumberland, which lies on the other side of the Solway Firth, the climate is moist, owing to its exposure to the Atlantic, and it produces grass in abundance. The arable land is also highly cultivated, under a regular course of cropping. In winter, throughout the Lowlands and the Lothians, the cattle are kept under cover, and are tended with great care and attention to their health and comfort.

Previous to the application of bone-manure by Mr. Sheriff, of East Lothian (about the commencement of the present century), the turnip culture was confined to the in-field, or manured portion of the farm; the out-field being chiefly in grass for some years, and then ploughed up and cropped with cereals successively, till it would bear no longer. To lands thus treated, the application of bone-dust was the very thing wanted to restore fertility. Continually fed by cattle or sheep, year after year, without any compensating return of the elements of production, the cattle being chiefly sent out of the country, which was thus deprived of the phosphates necessary for vegetation, the produce was barely sufficient to pay the expense of cultivation, and the out-field land might be considered as the make-weight, or "weighing piece," without which the farm could not be obtained, but which the farmer would willingly have dispensed with.

The bone manure, therefore, restored, at a comparatively small cost, that element of fertility, without a portion of which no corn can be produced, and the amount of which in a soil determines its ability to produce cereal crops. Applied to the turnip husbandry, its effects instantly brought it into general use, and the out-field lands were at once placed under the same course of husbandry with the in-field, namely, the five-course shift. These light lands have thus been enormously increased in value, and are quite equal in profitableness to those which had previously monopolised all the manure and attention of the farmers.

In no country is labour so well economised as in Scotland, and nowhere is it more efficient. The proportion of persons supported by the cultivation of the land is much less than in England, as the following statement shows :—

COMPARATIVE NUMBER OF PERSONS SUPPORTED BY AGRICULTURE IN ENGLAND, SCOTLAND, IRELAND, AND FRANCE.

England	12 to every 100 acres.
Scotland	5 ,, ,,
Ireland	24* ,, ,,
France	16 ,, ,,

The superintendence of the master over every kind of labour is incessant, which ensures its being well done, and with as little delay as possible. Most, if not all, of

* This was some years since; we believe it is now lower.

the Scottish farmers are practically acquainted with the various labours of husbandry, and are therefore well qualified for seeing that they are properly done. The farm-servants and labourers, therefore, know that it is at the peril of losing their employment if they neglect, or lounge over, or improperly perform the allotted task. The labourers, generally, are a well-conducted class, especially on the moderate-sized farms, on which the master has a control (if he wishes to exercise it) over the moral conduct of his men. There is, however, one flaw in the system, which has been the subject of much discussion in Scotland, and it is to be hoped it will lead to an alteration. We refer to the *bothy* system, by which all the unmarried servants of the farm are herded together in a hovel that the farmer would think it a disgrace for him to assign to his cattle. Some of the farmers have already improved these places, or erected improved *bothies;* but the system itself is bad, because it removes the young labourer from under the immediate control of the master when not at work, leaving him to the contaminating influence of whatever bad characters he may come into contact with. The employer is as much concerned in preserving him from this as the man is himself, and it is a short-sighted policy that leads him to neglect it.

In other respects, the rural population in Scotland are remarkably steady and respectable in their conduct and behaviour. They all receive an education in the parochial schools, which renders them intelligent to an extent far above the same class in England, whilst the attention paid to the Sabbath, and the universal attendance of the whole population on public worship on that day, imparts a steadiness and reflective turn to the character very favourable to good moral conduct. The servants are usually hired for the year or half year, and do not receive their money wages until the expiration of the term. But the usual mode of payment is half in money, and half in produce, so that the labourer has the latter to live on, and receives the former in one sum; which, after deducting what he requires for clothing, if he is a single man, is placed in a savings' bank to constitute a fund, on which to fall back, on his marriage, or in case of sickness or any other casualty. In some of the counties the largest portion of the wages is paid in kind; in which case, while the married men are well provided for, the unmarried have frequently produce to sell. The Scottish peasant is generally well dressed, and, on the Sunday, turns out to go to church in as good a coat as his master.

The establishment of an Agricultural Chemistry Association in Scotland is due to Mr. John Finnie, a farmer at Swanstone, in Mid-Lothian. The object he had primarily in view, was the prevention of the adulteration of artificial manures, which, it is well known, is practised to an enormous extent, and by which the farmers have been shamelessly plundered. As nothing but a rigid analysis can properly detect this species of robbery, Mr. Finnie conceived the idea of forming an association for the purpose of obtaining and remunerating the services of a first-rate analytical chemist, who would not only determine the value of a manure offered for sale, but by his knowledge of the nature of plants and their proper food, would be enabled to give the farmers information on the application of manures of the homestead, and also on the best methods of feeding live stock according to the properties of the food employed.

Mr. Finnie, in the first instance, wrote to Sir Charles Gordon, the secretary of the Highland Society, and requested him to lay the letter before the board of directors. The letter contained a rough draft of the plan on which he conceived the measure should be carried out by the society; but "cold water" being thrown upon it by the board, who replied, "that the object of the association was highly deserving the approbation of the society, and the best wishes of the directors for its success," Mr. Finnie drew up a prospectus, which he offered to the farmers at the market at Edinburgh, and had the satisfaction of obtaining the signatures of sixty farmers on the first day as annual subscribers. He then called a meeting at Edinburgh, at which he laid before the persons present the ideas he entertained and the objects of the proposed association. He also sent a letter to every landowner and tenant in Scotland, explaining its design, and calling on them to support it. At a subsequent meeting at Edinburgh, on which occasion Lord Viscount Melville took the chair, while Lord Dunfermline and many of the most eminent gentlemen of Scotland were present, resolutions were proposed and carried unanimously, and a committee chosen to promote the measure, with power to call a meeting of the subscribers on a certain day for the purpose of formally instituting the "Agricultural Chemistry Association of Scotland," and appointing the requisite officers.

This took place on the 11th of January, 1843, and in July following, the society was in full operation, Andrew Coventry, Esq., being appointed honorary secretary, with a numerous committee of noblemen and gentlemen, and a subscription-list of £900 per annum, each subscriber guaranteeing his subscription for five years. The committee received applications from ten persons offering themselves as chemical officer; but the selection fell upon Professor Johnstone, of Durham, who having accepted the appointment, entered upon his office at a salary of £500 per annum, and a moderate scale of charges for executing analyses. The association continued in existence five years; at the expiration of which (great bodies moving proverbially slow) the Highland Society began to conceive that a chemical department would be a proper adjunct to their institution. They therefore proposed that the association should be dissolved, and its labours transferred to the society; and upon the assurance of the directors that they would appoint a chemist, and give the tenant farmers the same privileges they enjoyed from the association, this latter was dissolved. Dr. Thomas Anderson was appointed chemical officer; and the results of his labours are now regularly inserted in the quarterly transactions of the Highland Society, published in Edinburgh.*

The quantity of land under a rotation of crops in Scotland, in 1857, was 3,556,572 acres, distributed in the following manner:—

Wheat.	Barley.	Oats.	Rye.	Bere.	Beans.	Peas.	Tares.	Turnips.	Potatoes.	Fallow.	Grass.
222,152½	198,387¾	938,613½	5,989½	21,607¼	39,186	3,687½	18,418¼.	476,691¾	139,819	18,582¾	1,459,305¾

TABLE OF ESTIMATED GROSS PRODUCE OF THE PRINCIPAL CROPS (IN BUSHELS), 1857.

Wheat.	Barley.	Oats.	Bere.	Beans, &c.	Turnips.	Potatoes.
6,154,986	6,524,429	32,750,763	671,778	1,037,760	6,690,109	430,468

The rotation of crops in the Lothians, and in Stirlingshire, is rigorously kept up, and is generally as follows:—1st, oats; 2nd, beans or potatoes; 3rd, wheat; 4th, turnips; 5th, wheat or barley; 6th, grass. This allows but few animals being kept in summer, the small quantity under grass only furnishing food for the horses and a few cattle or sheep. But in the winter, the cattle and sheep pastured on the mountains in summer are brought down to the Lowlands to be fattened. In Aberdeenshire the soil and climate are better adapted to forage crops, and the rotation is as follows:—1st, oats; 2nd, turnips;

* See Morton's Cyclopædia, article "Scottish Agriculture."

3rd, oats, barley, or bere; 4th, grass; 5th, grass; 6th, grass. Great numbers of fine cattle of the native breeds, or crossed with the short-horned, are fed here for the London market.

On the Cheviot and Lammermuir highlands a good deal of land has been brought under cultivation, and a large number of the Cheviot breed of sheep are also fed on the natural pastures. Some have crossed this breed with the Leicester, and produced thereby an excellent type that fattens early to a good size. They are generally got ready for the butcher about the beginning of June. In Berwickshire the five course rotation is observed—1st, oats; 2nd, turnips; 3rd, barley or wheat; 4th, grass; 5th, grass.

It appears by the figures of the statistics that the oat crop occupies fully one-fifth of the cultivated land of Scotland under rotation, turnips one-fifth, wheat and barley one fifth, grass nearly two-fifths. On the richer lands of Haddington, Stirling, Fife, and Perth, the extent of beans and peas is larger, being a good preparatory crop for wheat, the proportion of which is also increased. Potatoes also take the place of turnips, which are more cultivated in Banff than in Ayrshire. The western farms are smaller, and the moisture of the climate renders it more suitable for dairies, of which many are kept.

A very large proportion of the land in Scotland is incapable of cultivation, not only on account of its mountainous character, but owing to its sterility. Great improvements have been effected by draining and other methods, by which the natural grasses are rendered more productive, and the moory soils made capable of bearing the cattle and sheep upon them. These highlands are now divided into sheep farms of large size and at low rents, the valleys only being cultivated, of which the proportion is small. These new arrangements necessarily, in the first instance, caused great uneasiness by the dispossession of the old tenants, who most of them emigrated; but it is certain that the Highlands support and contain a larger population than they did before the new arrangements were effected, and that the material condition of the rural peasantry is much better.

SECTION III.

THE AGRICULTURE OF IRELAND.

In the history of the whole world there probably never was a more complete failure in a land system than in that of Ireland, or one which in its progress and final disruption inflicted more misery and disaster on all involved in it. The causes that have led to it are as numerous as the persons who have undertaken to explain them;* and so complicated were their nature, and so hopeless the prospect of their removal, that a violent and despotical interference of the legislature was at length found to be the only means by which the land could be restored to a condition profitable to the owner, the occupier, or the country at large.

* These may be enumerated as follows:—1st, the law of entails; 2nd, the improvidence of the landowners; 3rd, the system of middle-men; 4th, the subdivision of the soil; 5th, the want of a middle class; 6th, the absenteeism of proprietors; 7th, want of manufactures; 8th, excess of rural population; 9th, continual political and agrarian agitation; 10th, dependence of the cottiers on one kind of food; 11th, the effects of former misgovernment.

The native agricultural resources of Ireland are, at least, equal to those of England. The soil is of a generous staple, capable, with proper culture, of producing both cereal and all other crops in abundance, particularly roots, such as mangold-wurzel, turnips, potatoes, cabbages, &c. &c. Its pastures are proverbially rich in verdure, and their deep green hue, maintained throughout the year, has given to the country its sylvan name of *"the Emerald Isle,"* by which it is commonly known. Irrigated in all its extent by a thousand rivers, brooks, and springs issuing from the mountain range which occupies the centre of the island from north to south, and watered besides by gentle showers of rain, which, whilst not in the aggregate greater in amount than that which falls in England, is spread over a greater number of days, a florid vegetation is sustained throughout the year, exhibiting a freshness in winter, unknown at that season in England. We add to these advantages a mild and equable climate, never either hot or cold in excess, being tempered by the western breezes, which, passing over the tail of the gulf stream, prevail in Ireland at least nine months out of the twelve. With all these, and a thousand other sources of prosperity and wealth, the crisis of 1848 found the landed interest in Ireland steeped to the lips in poverty, helpless and hopeless of extricating itself by any efforts of its own; and the whole system collapsed like a huge balloon rent by a storm.

It would be foreign to our purpose to dilate upon the fearful miseries endured by the rural population during that awful visitation of famine, fever, and cholera combined; but we may state that these calamities, added to an extensive emigration, which deprived Ireland of upwards of two millions, or one-fourth of its population,* deprived also, to the same extent, the landowners of their tenantry, and consequently of their rent. And so extensively was this the case, that many large estates, especially in the west and south, had scarcely a tenant left; in some districts you might have travelled twenty miles without meeting a living man or animal of any description, or seeing a single field in which the operations of husbandry were carried on. It therefore became utterly impossible that the heavy encumbrances upon the estates could any longer be

* The writer, who resided in Ireland during that awful crisis, and had ample opportunity, by his connection with the press, of learning the leading facts, has made the following estimate of the loss of population, and the relative proportions due to disease and emigration:—

Population according to the census of 1841		8,174,031
Natural increase from 1841 to 1846,—7½ per cent.		613,050
Estimated population in 1846		8,787,081
Population according to census of 1851		6,550,210
Actual decrease		2,236,871
Emigrations from 1841 to 1851	1,600,000	
Decrease by disease „ „	636,871	2,236,871

The following are the returns in the "Blue Books" of the number of emigrants in the ten years from 1841 to 1851:—

1842	40,000	Brought forward	332,087
1843	40,469	1847	220,027
1844	58,285	1848	184,410
1845	86,949	1849	218,699
1846	106,384	1850	217,460
	332,087	1851	257,841
			1,430,524
		Migration to England and Scotland, and not accounted for in the Blue Books—say	169,476
			1,600 000

paid; and preparations were made throughout the country for throwing them into the Court of Chancery, which had already taken a considerable number of properties under its dubious protection.

Under these circumstances the legislature passed the bill for the establishment of the "Encumbered Estates Court," which is considered by all impartial persons as the only measure that has, or could have, saved the landed interest of Ireland from almost universal bankruptcy. Whatever hardships may have been inflicted in some cases, in the first instance, by the precipitate sale of properties whilst the country was still in a state of collapse, and the value of land at the lowest point, the advantages of making purchases under the act, soon became so apparent that a spirited competition arose, which soon restored the confidence of the public in the natural resources of the country, and its ability by a new and vigorous development of them, to recover itself and enter upon a course of prosperity. By the division of the large estates submitted to the operations of the act into farms, a considerable proportion of land has been purchased by farmers who occupy and farm it themselves; and thus has been created, what was so much wanted in Ireland, a middle class of yeomanry, whose interest in the welfare of the country is the strongest safeguard of its stability and prosperity.

Another advantage arising from the measure was the infusion of capital, and its direct application to the land in the manner most profitable to the country. Formerly, what with the absenteeism of the landowners, and the large sums paid to mortgagees, annuitants, and other non-resident claimants upon property, a very small proportion of the rental of many estates remained to be spent in the country, whilst the corn and cattle were also in a great measure sent over to England, the population in the rural districts subsisting chiefly upon buttermilk and potatoes. But under the new system the land which had been abandoned by its tenantry, being placed under the operation of the court, was purchased to a great extent by residents, or persons who intended to reside upon their newly purchased properties, and to expend the produce in the country.

Another important alteration in the land system is the amalgamation of the small holdings, so as to form moderate sized farms, by which a better and regular system of husbandry is rendered possible, which was not the case before. When Sir Robert (then Mr.) Kane, in 1844, wrote his celebrated work on the "Industrial Resources of Ireland," the subdivision of the land had reached its culminating point, having been encouraged, and almost enforced, by the political agitators of the time, in order to promote their incendiary purposes. The entire area of land in Ireland, according to Sir Robert Kane ("Industrial Resources," p. 241), was 20,808,271 acres,* distributed as follows:—

Arable land	13,464,300	acres.
Plantations	374,482	,,
Under towns and villages	42,929	,,
Uncultivated	6,295,735	,,
Lakes and rivers	630,825	,,
	20,808,271	,,

* The proportions in the different provinces were—

	Acres.	Roods.	Poles.
Ulster	5,312,189	0	13
Munster	4,834,865	1	18
Leinster	5,934,789	2	29
Connaught	4,233,196	1	0
	20,315,040	1	20

This statement differs from the above, but the latter being taken from the "survey," may therefore be considered correct.

The cultivated land was divided into holdings as follows, according to the census of 1841 :—

Farms of from 1 to 5 acres	306,915	558,043
" " 5 " 15 "	251,128	
" " 15 " 30 "	78,954	127,266
" above 30 "	48,312	
	685,309	

These proportions were reduced in 1857 in the following ratio :—

Farms of from 1 to 5 acres	119,084	298,817
" " 5 " 15 "	179,733	
" " 15 " 30 "	139,192	295,575
" above 30	156,383	
	594,392	

The following is the abstract of the crops for the four years from 1855 to 1858 inclusive :—

	1855.	1856.	1857.	1858.
	Acres.	Acres.	Acres.	Acres.
Wheat	445,775	529,050	559,646	551,386
Oats	2,118,858	2,037,437	1,980,934	1,976,929
Barley	226,629	182,796	211,288	190,721
Bere and rye	22,817	19,891	21,374	16,489
Beans and peas	18,485	16,034	13,586	12,876
Potatoes	982,301	1,104,704	1,146,647	1,160,056
Turnips	366,953	354,451	350,047	337,077
Mangolds	22,567	22,201	21,629	30,027
Cabbage	24,121	27,968	30,011	33,107
Parsnips and carrots	19,042	20,734	21,602	23,450
Tares and rape	29,406	29,183	34,740	33,441
Flax	97,075	106,311	97,741	91,555
Meadow and clover	1,314,307	1,302,787	1,369,892	1,424,578

And the following is the average produce per acre, for ten years, from 1849 to 1858 inclusive :—

Wheat	5·7 barrels of	20 stone each,	equal to	$26\frac{1}{2}$ bushels.
Oats	7·8 "	14 "	"	$38\frac{1}{10}$ "
Barley	8·5 "	16 "	"	38 "
Bere	8· "	16 "	"	36 "
Rye	7·1 "	20 "	"	35 "
Beans and peas	$27\frac{1}{4}$ bushels of 8 gallons each.			
Potatoes	39·4 barrels of 20 stone each		"	180 "
Turnips	15·1 tons.			
Mangolds	16·6 "			
Cabbage	13·1 "			
Flax	35·8 stone of 14 lbs. each.			
Hay	2 tons.			

The entire quantity of land in the possession of freeholders in 1848, according to the Registrar-General's report, was 20,220,502 acres, of which 4,674,423 acres were returned as under bog, or unallotted waste; 2,162,421 in farms under 15 acres; 9,927,959 from 15 to 100 acres; 3,232,927 from 100 to 200; and 4,897,275 in farms of upwards of 200 acres.

The next table gives the number of live stock, and shows the increase in four years, from 1855 to 1858 inclusive :—

	Horses.	Cattle.	Sheep.	Pigs.	Value.
1855	556,287	3,564,400	3,602,342	1,177,605	£33,053,478
1856	573,403	3,587,858	3,694,294	918,525	33,120,220
1857	599,782	3,620,954	3,452,252	1,255,186	33,700,916
1858	601,717	3,661,594	3,487,785	1,402,812	34,276,175
	Increase.	Increase.	Decrease.	Increase.	Increase.
	45,430	97,194	114,557	225,207	£1,222,697

One of the largest benefits bestowed by the Encumbered Estates Court upon the land of Ireland is the undeniable title it confers upon all purchases effected in it. The process is as follows :—When a petition for the sale of an estate is presented to the court, whether by the nominal proprietor or an encumbrancer, his right to do so being ascertained, notice of the fact is given by advertisement in the public journals, in which claimants upon the property are required to come forward and assert their pretensions against a certain day, otherwise the sale of the property will take place, and they will hereafter be excluded from all participation in the proceeds. Every claim thus put forward is investigated and argued in open court by professional men, the same as in other courts of law, and admitted or rejected according as the evidence establishes, or otherwise, a legal or equitable right. The decision of the court is final, and not, we believe, subject to a revision by any other court; and these preliminaries being adjusted, the estate is put up, either whole or in parts, and sold by the commissioners to the highest bidder; and, the purchase money being paid, a title is given which can never be the subject of litigation, except at the expense and risk of the plaintiff in the case.*

Previous to the establishment of this court, there was scarcely an estate in Ireland

* A remarkable instance of this kind occurred in the case of one of the first (if not *the* first) estates sold by the court. This property, which consisted of several thousand acres, chiefly of wild mountain-land on the western coast, was sold under peculiar circumstances, at so low a price, that it was urged by the opponents of the act as a proof of the wanton spoliation of property to which the owners of estates would be subject. The price was £500; but so little was it considered worth the money, that the purchaser availed himself of some technical quibble and threw up the bargain. It was again sold at a lower price, and again thrown up. A third time, upon being submitted to sale, it was purchased by a wealthy Dublin tradesman for £350, and the bargain was this time concluded, and a title given.

Soon after, the purchaser went to look over his newly-acquired property, which he found to consist, apparently, of chiefly barren granite rock, in the condition in which nature left it at the creation. In walking along the sea-shore, he thought he perceived indications of some sort of metallic ore. In order to ascertain what it was, he procured some peasants with pick-axes and spades, and soon raised a few tons, which turned out to be very rich copper ore, worth, at Swansea, from £50 to £60 per ton! The affair soon became known: and in the course of a few weeks the proprietor had let the working of the mine to a mining company at £1,000 per annum.

It happened, however, that about seventy years before, the then proprietor of the estate had exchanged it with the Marquis of Sligo for some land in the county of Sligo, and the marquis had sold it to the family of the party who placed it in the court, and who was at once owner, petitioner, and solicitor. The descendant of the original owner hearing of the discovery, wrote to the purchaser, requesting to be allowed to visit the old spot. This was granted; but what was the astonishment of the purchaser on being served with an injunction from the Court of Chancery, restraining him and all other persons from working any mines whatever upon the estate, on the plea that the exchange with the Marquis of Sligo extended no further than to the surface, all "mines and royalties" being left out of the deed of contract, and, therefore, remaining the property of the original owner or his heirs. Had this estate been sold in the ordinary course of business, the seller could not have given a title that would have covered the "mines and royalties;" but the precautions taken by the commissioners of the court, in advertising for claimants of *every description*, and none appearing, the estate was sold absolutely, with the "mines and royalties" expressed in the deed. The claimant, therefore, came too late, and the Court of Chancery having no power to set aside the deed, the claim was annulled. We understand that the proprietor has discovered another copper mine upon the property, which he has let at the same rent as the first.—See the article "Irish Agriculture," in the *Edinburgh Journal of Agriculture*, by the author of this work.

to which a free and indefeasible title could be given, and it was dangerous, as well as expensive, to attempt to make a purchase. The charge for undertaking to search the register for the title of a large property was not less than £500. In some cases, the charges upon estates dated more than a hundred years back, and in one case that came under the notice of the writer, they numbered a hundred and fifty, embracing every possible description of claim the law could invent or the proprietor grant. The task, therefore, of searching the register implied a tedious and minute examination; and the negligence of a solicitor might involve a purchaser in ruinous litigation. This Gordian knot was cut by the Encumbered Estates Court, by throwing the onus of establishing a claim, by a certain day, upon the claimant, and barring, by its final decision, all future litigation on the question of title.

The result of this security in purchasing property under the act has been most beneficial. A large number of English and Scottish capitalists and farmers have hired or made purchases of land in every part of Ireland, and have introduced there the system of husbandry practised in their own country, thereby changing the entire appearance of the land. Up to the year 1858, the number of these new settlers amounted to 756, namely, 660 Scottish, and 96 English. As tenants, those of them who have hired farms have been granted long leases (generally thirty-one years) at comparatively low rents, in order to induce others to come forward. Most of these have taken over with them Scotch or English labourers or stewards to superintend and instruct the native peasantry. The number of these immigrants, with their families, amount to some thousands, and by their careful and industrious habits, cannot fail to exercise a beneficial influence upon those by whom they are surrounded.

This migration of British agriculturists, and their distribution throughout the country, is, in fact, producing a complete revolution in husbandry and in the character of the rural peasantry. The physical appearance of the land, as well as of the people, is undergoing a remarkable change. Industry has taken the place of idleness; wages have risen from 4*d.*, 6*d.*, and 8*d.* per day, to 1*s.*, 1*s.* 3*d.*, and 1*s.* 6*d.*; and at harvest time almost any price may be obtained for efficient labour. The large diminution of the rural peasantry, however lamentable may have been the cause, has undoubtedly relieved the country from a load of pauperism and misery that weighed principally upon the land, and prevented all attempts at improvement. The poor's rates, which at one time threatened to swallow up the whole produce of the land, have fallen below those of England, and in some districts are not more than from 4*d.* in the pound, as the minimum, to 1*s.* 6*d.*, the maximum; in very few cases being so high as the latter. According to the census of the present year (1861), the diminution of the population is still going on. Without any other cause than that of emigration, the decrease amounts to 785,667, the emigration in the ten years since 1851 being 1,230,986.*

* The following statement exhibits the actual state of the population :—

Present number, according to the census	5,764,543
Emigration in ten years	1,230,986
Number, if all had remained	6,995,529
Population according to the census of 1851	6,550,210
Number due to natural increase	445,319

This gives only about $6\frac{3}{4}$ per cent. of births over deaths; and if the immigration of English and Scotch were deducted, the decrease would have been much larger.

This is matter of considerable surprise, there being no weighty cause now existing to render a removal to another country necessary or desirable. The effect, however, will be to raise the price of labour, and, at the same time, cause the increased use of machinery in agriculture.

We should be failing in a duty we owe to a most beneficial institution if we were to omit to mention the incessant and patriotic exertions of the Royal Dublin Society, as well as those of the Royal Agricultural Society of Ireland, to promote the interests of agriculture in that country. The annual shows of the latter have been productive of a spirit of emulation throughout the country, both in the breeding and rearing of live stock, and in the improvement of the soil. By their efforts and instructions, a more rational system of husbandry is fast gaining ground, and root and green crops are becoming almost universally prevalent as a necessary part of a course of cropping, and artificial manures are extensively used. Some of the richest lands in Ireland, which, previous to the famine, were known to produce upwards of twenty barrels of wheat, of twenty stone each, per acre (amounting to ninety-three bushels per *Irish acre,* which is about one and a half acres English), were so reduced by exhaustion and the want of lime, that they fell off to a produce of from five to eight barrels, and it became a question with many whether it could ever recover its fertility, and whether wheat could ever again be cultivated to advantage. Lime is found to be an essential dressing for wheat in Ireland; and it is a remarkable fact, that whilst a large portion of the country lies over a deep limestone subsoil, not a particle of calcareous matter has been discovered in the surface soil, proving that it has been formed of the *débris* of rocks at a distance, in which no limestone exists.

The societies we refer to, have also employed lecturers to instruct the people in the principles of farming, by which useful information is disseminated. By their efforts too, Chairs of Agriculture have been instituted in all the Queen's colleges; and a great number of youths are in constant attendance upon the lectures delivered by the professors and others on the subject of husbandry. All their efforts, however, were in the first instance baffled by the innumerable evils under which the landed property of Ireland was weighed down, and prosperity and progress were alike rendered hopeless. Since the breaking down of the system, and the transfer of the land to new owners and occupiers, their exertions have been unremitting; and, having a better material to work upon, success is crowning their efforts. Ireland has made a greater progress during the last twelve years than any country in the world, and, assisted by the aid of general and local Agricultural Associations, must still advance. Both soil and climate are particularly favourable to the breeding and grazing of cattle and sheep, from the luxuriance of its pasture-grounds, and the adaptation of the soil to the cultivation and growth of roots and artificial grasses. The produce of mangold-wurzel, when well manured, is extraordinary, amounting, on some soils, to seventy or eighty tons per acre.

Hitherto, the north of Ireland has been the best cultivated part, being to a considerable extent occupied by the descendants of Scottish settlers. Although the land was as much subdivided in Ulster as in other parts, the rural classes were in a far better state than those of the south and west. This is to be ascribed to the union of manufacture with agriculture which prevailed there, almost all the female part of the population being engaged either in the weaving of linen or in the sewed muslin trade, of which an immense quantity is done in that part of the island. The flax culture and

manufacture also employ a large number of persons of both sexes, and a great amount of money is paid to them as wages, by which their condition is rendered far more comfortable than that of their countrymen of the other provinces. Although the land in the north is generally less fertile than that of the south and centre, the farms exhibited much better management and system of tillage, so that a traveller, if ever so little acquainted with the country, in going from the south to the north, could not fail to be struck with the difference. This, however, is much less the case now than it was ten years ago, so greatly has the face of the whole country been changed during that period. In remarking upon this improvement Lavergne wrote as follows: "This frightful calamity (the famine) has effected what years of war and oppression failed to do—it has subdued Ireland. . . . What was before impossible in rural economy, henceforth becomes easy. The too great division of the farms is no longer a matter of necessity. In place of seven hundred thousand farms, there may be now, and indeed ought to be, only half the number, and, consequently, of twice the size. Where two families of cultivators were unable to exist, one may in future live in comfort. Potatoes and oats, which had been grown in excess, may now be reduced within proper bounds. The four-course system may be more extended, and with it, rural prosperity, of which it is a token. Meadows and pastures, hitherto neglected, begin to receive the attention they merit, and which they ought to repay a hundredfold. Ireland will again become—what she should never have ceased to be—the Emerald Isle, *par excellence;* that is to say, the finest grass country in the world. Cattle, which were never sufficiently encouraged, because the population could not find enough to feed themselves, will now find a more abundant alimentation. Wages being no longer unduly depressed by a superabundance of hands, labour becomes more productive and better paid; and, provided the impetus imparted to manufactures and commerce for the last few years is maintained and increased, the over-crowding of the fields need no longer be feared, even should the population rise again to its former level."

The above was written in 1854, and up to this time the anticipations of the writer have been fully realized, but certainly the whole is not due to the famine. That calamity only prepared the way, and the Encumbered Estates Court has been the main instrument in the renovation of the country. Had the estates been thrown into the Court of Chancery, which they would and *must* have been but for the institution of the former court, the consequences would have been the most ruinous it is possible to conceive, and instead of a revival of prosperity, the land of Ireland would have been doomed to perpetual sterility and unproductiveness. There is abundant evidence that such would have been the result, in the condition of those estates which had been placed under the superintendence of Chancery. What with the interminable litigation that was sure to follow,* and the abominable management of the agents employed, such

* The Duke de Grammont asked the Chancellor D'Aguesseau on some occasion, whether, with his experience of the chicanery in legal processes, and of their length, he had never thought of some regulation which would put an end to them? "I had gone so far," replied the chancellor, "as to commit a plan of such a regulation to writing; but after I had made some progress, I reflected on the great number of advocates, attorneys, and officers of justice whom it would ruin; compassion for them made the pen fall from my hand. The length and number of lawsuits confer on the gentlemen of the long robe their wealth and authority; *one must therefore continue to permit their infant growth and everlasting endurance.*" (See Butler's "Reminiscences," p. 58.) The same selfish and unworthy motive caused the strenuous opposition of the Irish lawyers to the Encumbered Estates Acts, and still prevents the passing of a similar measure for England. The contrast between light and darkness is not greater than that between the Encumbered Estates Court in Ireland and the Court of Chancery.

properties became nothing else than a prey to the "gentlemen of the long robe" who had the good fortune to be engaged in the suits, and who generally managed to absorb all that was left of them in the expenses.

The importance of the institution of the Encumbered Estates Court will be at once admitted when we consider the vast extent of its operations. The following is a summary of its proceedings during the twelve years that the act has been in force:—

"In 1848, the Act 11 and 12 Vict., c. 48, to facilitate the sale of encumbered estates in Ireland was passed; but owing to the defectiveness of its construction it proved wholly inoperative; and in the following year, 1849, the Act of 12 and 13 Vict., c. 77, was passed. Under the provisions of this act, a royal commission was issued, under the title of 'The Commission for sale of Encumbered Estates in Ireland,' having three commissioners, appointed by the crown; and to be a Court of Record, with powers to frame rules for regulating its proceedings; which rules, when approved of by the Privy Council and enrolled in Chancery, were to have the same authority as if enacted by parliament.

"The commissioners commenced their sittings for the despatch of business in October, 1849. The total number of petitions presented to the commissioners in the eight years ended 31st August, 1857, were 4,413. Of these 1,363 have been lodged by owners, and the court has made 3,547 absolute orders for sale. The first sale was held on the 21st of February, 1850.

"In 1858, an act was passed extending the powers of the Encumbered Estates Court for the sale of encumbered properties to properties that are unencumbered. By this act, the judges and officers of the former court are transferred to a new court, called 'The Landed Estates Court,' which commenced its sittings on the 1st of November.

"The gross amount produced by sales from October, 1849, up to August, 1859, was £25,190,839. The court has distributed to creditors £24,229,027, inclusive of £3,692,611 allowed to encumbrancers who became purchasers. A sum of £961,809 remains in hand to satisfy unadjusted claims."*

The effect of the liberation of so large an extent of property from the weight of encumbrances under which it had lain, and the admission of such an influx of capital in its cultivation as has been already expended, may readily be conceived. The want of this latter was one of the great excuses for the little progress made in agriculture and other industrial pursuits; the real fact, however, was, that there was no real want of capital in Ireland, as was proved by the Irish investments in the English funds, amounting to several millions annually; and the additional fact, that most of the land sold under the act has been purchased by Irishmen and paid for with Irish capital. The main cause was the insecurity hanging over the possession of land, whether as proprietor or tenant, but especially the former, on account of the number of claimants who in many cases started up† to dispute a title to landed property with the nominal owner. On the other hand, it was dangerous for a farmer to take land as a tenant, lest he should be committing an agrarian crime against the laws of the Ribbon Society, which was sure to be visited with condign punishment.

* See Thom's "Dublin Directory," for 1861.

† A friend of the writer's tenanted a property in Ireland, for the rent of which five claimants served him with notices of action if it was not paid to them. The result was, he held the property for some years, and by the advice of a clever lawyer, paid nothing, and was never sued for it.

These are no fictitious or slight obstacles in the way of Ireland's prosperity. Numberless instances have occurred in which murder has resulted, or gross outrages at least been committed, upon persons hiring land that was claimed by others as tenants. Nor have purchasers under the Encumbered Estates Act been in all cases allowed to hold possession with impunity, several lives having been sacrificed to the lawless and vindictive vengeance of the Ribbon Society, whose baneful influence is felt in every part of Ireland, and the existence of which is a standing reproach to the nation at large. There is not a doubt that it is in the power of the Roman Catholic priesthood to put down the society if they chose; but there is too much reason to believe, that while ostensibly pretending to discountenance, they secretly encourage it. Catholics, when asked why they pay no attention to the denunciations of the priests, reply at once, "Because we do not believe they are in earnest in their denunciations."* Nor is it possible for them to suppose their priests sincere, when the latter denounce the victims of the society at the altar *before* a murder, and absolve the murderer immediately after it, and, in some cases, also before.

Nothing is wanting to the increase of Ireland's prosperity and happiness but the entire suppression of that agitation which has been all along its bane and its disgrace. "With every element of wealth in its soil, and with a climate incomparable to that of either England or Scotland in salubrity and adaptation to the pursuits of agriculture, she only wants to be freed from those secret associations which every now and then manifest their presence by agrarian outrages and lawless denunciations, and which have to so great an extent prevented capital and skill from flowing into the country, whilst it has driven some of the most valuable characters to absent themselves from their estates, and to reside where they can live unmolested and at peace. Emigration, it is true, has removed a large portion of the population most addicted to those unmanly and dastardly crimes which inflict so deep a stain upon the national character. Recent events, however, unfortunately prove that the spirit is still latent, and that human life is considered of no value, when set in competition with the possession of a patch of land, or any other agrarian object. The cry of 'Ireland for the Irish' is still acted upon, if not openly pronounced, notwithstanding the advantages the country has derived from the establishment of English and Scottish agriculturists, and the improved condition of the peasantry consequent on the great advance in the price of labour."†

SECTION IV.

HISTORY OF FRENCH AGRICULTURE.

It has been remarked by an eminent writer that "the history of the kingdom of France affords a striking example of how little can be done towards the improvement of agriculture by the mere efforts of government or of speculative men in publishing books

* See evidence of H. W. Rowan, Esq., before the committee of the Lords in 1839.

† See *Journal of Agriculture* for 1859, p. 185.

or offering premiums for treatises on the subject." This, however, although true, is not the whole truth. The writer (Forsyth) might have added that the necessity for the interference of a government in agriculture can only exist under a despotism, and that agriculture, as well as every other industry, requires perfect freedom of action to ensure success and progress. France affords a complete illustration of the evils arising from a want, or the absence, of such freedom.

At the commencement of the seventeenth century great efforts were made in France to revive agriculture in that country. Many eminent writers arose, and works of great merit were published by Palissy, Olivier Deserres, Lebault, and others. The second of these, Deserres, possessed a considerable landed property at Pradel, in Vivarais, where he lived a retired life and cultivated his own estate. His principal work was the "Théâtre d'Agriculture," which was published in 1600, and is reckoned by Lavergne as the best treatise on agriculture existing in any modern language. "All the good systems of agriculture," says Mr. Lavergne, "were known in Olivier's time. He gives directions which might be followed by our agriculturists at the present day. Production made rapid progress in the course of a few years '*to the great profit of your people,*' he says, addressing the king in his dedication, '*dwelling safely under their fig-tree, cultivating their land; and who, under shelter of your majesty, have justice and peace dwelling with them.*' "*

Provence and Languedoc, on the borders of which Deserre's estate was situated, were considered the best cultivated parts of France at this period. The assassination of Henry IV., after a few years, put a stop in a great measure to the prosperity of agriculture. Louis XIII., who succeeded him, was a minor, and at his death in 1643 his son, and heir to the crown, Louis XIV., was only five years of age. At this period the country districts of France were inhabited by the nobility, who, in the midst of their peasantry, cultivated the land, and promoted the interests of the rural population, with whom they identified themselves.

The grandeur of the court of Louis XIV. attracted to the metropolis most of the nobles, and by degrees estranged them from the love of a country life. The enormous expenses and destructive wars of the sovereign, who literally made war a game of hazard, exhausted the resources, and threw back the prosperity of France. Its reflux action, too, upon the courtiers, who imitated the splendour of their master, was no less injurious to the industrial portion of the country. All the youth of the rural districts were drafted off to fill up the ranks of the army, and the entire population decreased. While in England, after the revolution of 1688, agriculture made such rapid progress that she was enabled to export corn to the amount of from 500,000 to 1,000,000 quarters annually, France, which in the seventeenth century supplied England, was scarcely able to feed her own population.

Nothing is more destructive of agriculture than the war spirit and the passion for "national glory," as it is termed. When once this has taken possession of a people there is an end to industrial prosperity. A constant craving for exciting scenes and exciting news weakens the hands, while the gratification of the desire exhausts the resources of labour. The wars in which Louis XIV. and his profligate successor engaged impoverished France, weaned the country gentlemen from the fondness of a rural life, and thus left the peasantry to themselves, and the merciless superintendence of stewards,

* Lavergne, "Rural Economy of England and Scotland," &c., p. 138.

whose only business was to extort from them the highest rent their industry would yield. In 1750, out of 125,000,000 acres (the extent of France without Corsica and Lorraine, which did not then belong to her), only 45,000,000 were cultivated, of which 8,000,000 were under large, and thirty-seven under small, farming. By large farms, Quesnay, who makes the statement, means those on which horses were employed for tillage, and farmed on the triennial rotation of wheat, oats, and fallow; the small farmers being the *métayers* whose course was biennial, namely, wheat and fallow. "This division," says Lavergne, "ought to be quite correct, *for it corresponds with the existing state of things.* France continues still divided into two distinct regions, the one in the north, where the lease system prevails, tillage by horses, and triennial rotation more or less modified; the other, the south, where small holdings predominate, labour by cattle, and biennial rotation; only since 1750 the first has gained ground and the latter has declined." *

The reign of Louis XV. was most disastrous to France. The utter disregard of that profligate sovereign to the distresses of his people, and the determination, at all hazards and expenditure, to gratify his own selfish indulgence, laid the foundation of that frightful drama which commenced in 1789, and is still in progress: for all the changes that have taken place in that distracted country, all the misfortunes and disgraces to which it has been compelled to submit, are but so many acts and incidents of the same drama, the plot of which is by no means wound up; nor is it likely that any permanent improvement in the industrial interests of the country can be established, whilst the military spirit of the nation predominates—until the ploughshare shall take the place of the sword, and the pruning-hook of the spear. A nation upheld by peaceful industry has a fund of wealth and loyalty to fall back upon when the defence of its territory calls for it; but one that bases its glory and strength upon the number of its standing army, which constitutes a permanent menace to the surrounding states, is sure in the end to be compelled to succumb to the enemies it has raised up.

The condition of the whole population of France, not excepting even the upper classes, or the proprietors of estates, is described as wretched in the extreme in 1750. The net revenue from the arable or corn lands was not more than £3,200,000, and that of the vineyards about as much more. The rent of the large farms was at the rate of 5 livres per arpent ($1\frac{1}{4}$ acre), and that of the small farms from 20 to 30 sous; say 3*s.* 6*d.* for the first, and 9*d.* to 1*s.* for the second per acre. The produce of the large farm land was seventeen bushels, and of the small eight and a half bushels per acre. The number of horned cattle was 5,000,000, and those slaughtered for food only from 400,000 to 500,000 per year. Previous to this period (1739) the Marquis d'Argenson speaks as follows of the distress of the people:—"The real evil, that which undermines the kingdom and cannot fail to bring ruin upon it, is that at Versailles they shut their eyes too much to the distressing state of things in the provinces. In my own days I have observed a gradual decrease of wealth and population in France. We have the present certainty that misery has become general to an unheard-of degree. While I write in the midst of profound peace, with indications, if not of abundance, at least of an average harvest, *men are dying around us like flies of want, and eating grass.* The provinces of Maine, Angoumis, Touraine, Haute-Poitou, Perigord, Orléannais, and Berry are the most wretched, and the distress is advancing towards Versailles. The Duke of Orleans lately laid before the council a piece of bread, which we got for him,

* "Rural Economy of England, Scotland," &c., 141.

made of ferns; in placing it upon the king's table he said, '*Sire, here is what your subjects live on!*'"

Such was the state of things up to the time when Louis XVI. ascended the throne of France in May, 1774; and all impartial historians agree in representing him to have been really desirous of promoting to the utmost of his power the prosperity of the country. Agriculture was encouraged and began to revive, and free scope was given to labour and commerce in grain, which latter was entirely a new idea in France. Many reforms of an useful character had been effected previous to 1789, when the revolution commenced, which soon resulted in the destruction of the monarchy, and the establishment of a state of anarchy, which naturally led to a despotism so much worse than that of the Bourbons, that it had its sole foundation in military power and its support in the military spirit.

Louis XVI. had abolished the feudal rights of the seigneurs, which was confirmed by the law of the Convention of September, 1791. It was thereby enacted that "the territory of France in all its extent is as free as the persons who inhabit it, so that all territorial property can be subject only to customs established or recognised by the law, and to the sacrifices required by the public welfare, under the condition of a just and preliminary indemnity;" and that "the proprietors are free to vary at will the cultivation of their lands, to store and keep at will their corn, and to dispose of all the produce of their farms, either at home or in foreign parts, without prejudice to the rights of others, and in conformity to the laws." These principles were scarcely sanctioned and adopted by the Convention, than they were violated by the turbulent governments which succeeded the breaking up of the monarchy. In the convulsion which ensued, all the bonds which held society together were ruthlessly snapped asunder. The lords of the soil were massacred or driven from their country. In either case their estates were forfeited to the republic, and sold so far as purchasers could be found. The property of the church, also, and of the ecclesiastical and religious institutions was sold, and amounted, according to Treillard, to nearly £167,000,000 sterling, being in some of the provinces one-third, and in others one-half of the real property. It may easily be conceived, not only what a change the sale of this enormous quantity of land, all thrown into the market at once, must have created, but what a hindrance the convulsion which occasioned it, and the confusion which followed, must have presented to the cultivation of the soil. To these drawbacks were added the continual drafts upon the rural population of the best men to serve in the immense armaments necessarily kept on foot by the ever-changing governments, on the one hand to keep at bay the enemies of the republic, and on the other to carry the war beyond the frontier, and attack those enemies on their own ground.

A *levée-en-masse* on the 22nd August, 1793, declared that "*all Frenchmen* will be required for the service of the republic. The young men will go to battle, the married will forge arms and transport provisions; the women will make tents and clothes, and attend the hospitals; the children will convert old linen into lint; the old men will be taken to the public squares, to rouse the courage of the warriors, and preach hatred to kings and love to the republic," &c. &c. Where then were the hands that were to till the soil? The natural consequence of the revolutionary madness was famine and scarcity. Had the decree been carried out to the letter, there would have remained neither man nor beast to furnish food for the country.

The subsidence of the first horrors of the revolution brought no respite to the rural inhabitants. Such was the want of a proper and efficient system of police, that bands of robbers infested all the public roads, even up to the very gates of Paris, rendering it dangerous to travel, and even to reside in any secluded situation. These brigands called themselves *chauffeurs*, because they made a point of burning the feet of their victims to extort money from them, or compel them to tell where they had concealed it, nor was there any mitigation of these hideous evils until 1803, when Napoleon became first consul, and directed movable columns to traverse the country to try, by military commissions, the robbers they could apprehend. Thus, from the commencement of the revolution to the date just stated, agriculture, as well as every other branch of industry, languished; and notwithstanding the efforts of Napoleon, first as consul and afterwards as emperor, to resuscitate the industrial spirit, the renewal and continuance of the war, and the universal passion for the phantom of "national glory," as it was called, but which in less courtly phrase might be termed "national madness," neutralised to a great extent the efforts of the government, and caused agriculture to decline. M. de Lavergne shows, by reference to statistics, that whatever progress was made between 1789 and 1815 was during the consulate, and, therefore, that neither to the republic, nor to the empire was France indebted for any addition to the territorial wealth of the country.

The only redeeming feature in this picture is that the establishment for promoting the breeding of Merino sheep at Rambouillet survived the ravages of the revolution, and to this day remains a monument of the patriotism of Louis XVI., by whom it was first instituted. One other source of wealth was inaugurated at this period, arising rather out of the disasters of the country than from any preconceived notion of improvement; this was the cultivation of the Silesian beetroot, and the manufacture of sugar therefrom. France had lost, one after another, all her sugar colonies in the West Indies, and in the Indian Ocean. These had been taken by the squadrons of Great Britain, which had thus acquired almost the whole monopoly of sugar. Galled at the idea of having to purchase this necessary condiment of his detested rival, Napoleon issued the famous Berlin and Milan decrees, which prohibited all kinds of British produce from the Continent: at the same time prizes were offered for the discovery of the best mode of manufacturing sugar from European vegetables. Chemists were set to work upon this scheme, and M. Achard, a Prussian, formed the first establishment for the purpose. It succeeded, and the manufacture was speedily introduced into France under the warmest patronage of the emperor, who directed that 100,000 acres, at least, of beetroot should be cultivated for the purpose. The sugar at first produced was of a wretchedly inferior quality, and nothing but necessity would have induced the people to use it. After the peace of 1815 it was ill calculated to stand a competition with the produce of the West or East Indies; and notwithstanding an almost prohibitory duty on the latter, the native manufacture for a time declined; but the ingenuity and perseverance of the French chemists and machinists at length overcame every obstacle, and their efforts were crowned with such success that for many years the beet-sugar manufacture has been one of the most profitable and valuable objects of industry in the Northern Departments of France.

One of the most influential features of the land system of France, is that arising out of the law of succession, which provides that upon the death of a proprietor intestate his real property shall be divided equally amongst all his children, both male and female. We have alluded to the system of small farms already as being more numerous in France even before the revolution than large ones; but these referred to a great extent to tenant farmers, and not to proprietors. To show the proportion in which the small proprietors in land have increased, we may state that in 1815 there were—

21,456	families possessing	an average of	2,172	acres.
168,643	,,	,,	153	,,
217,817	,,	,,	54	,,
256,533	,,	,,	29	,,
258,452	,,	,,	19	,,
361,711	,,	,,	12	,
567,687	,,	,,	7	,,
851,280	,,	,,	4	,,
1,101,421	,,	,,	1	,,
3,805,000				

At the present time the distribution stands as follows :—

50,000	proprietors holding	an average of	737	acres.
500,000	,,	,,	74	,,
5,000,000	,,	,,	7	,,
5,550,000				

These figures speak for themselves, and the subdivision is still going on, leading to an entanglement of property that has created alarm amongst the most strenuous advocates of the system.*

After the restoration in 1815 a season of agricultural prosperity succeeded. The industrial spirit of the people rose with the return of peace, and the cessation of that excitement which the stirring events of the previous twenty years occasioned and kept alive. This prosperity continued until the expulsion of Louis Philippe from the throne of France in 1848, after which it has again declined. It speaks but little in favour of the empire that under both the first and the second industrial pursuits have made no progress, notwithstanding that, under both, the efforts of the government to promote it have been unceasing. Agricultural associations have been instituted, shows have been held, and every inducement put forward for the agriculturists to adopt the best modes of cultivation; but the effect has been feeble, and it seems impossible to overcome the causes which appear to weigh down the spirit of enterprise. M. Lavergne ascribes this, first, to the destruction of the potatoes; secondly, to the events of 1848; thirdly, to the bad harvests of 1853 and 1855; fourthly, to the Crimean war; fifthly, to the cholera; sixthly, the war in Italy; seventhly, the public works of Paris and other large towns, which have drained the rural districts of a vast number of the best hands. He might have added to the list the operation of the conscription law, which annually takes away

* The great evil of small farming is the total inability of the holders to make those improvements which are continually being discovered in rural economy. Arthur Young has graphically described this inability of the small farmer in the following words :—"Let me ask of the advocates of small farms where the little farmer is to be found who will cover his whole farm with marl at the rate of 100 or 150 tons per acre; who will drain all his land at the expense of two or three pounds per acre; who will pay a heavy price for the manure of towns, and convey it thirty miles by land-carriage; who will float his meadows at the expense of five pounds per acre; who, to improve the breed of sheep, will give 1,000 guineas for the use of a single ram for a single season; who will give twenty-five guineas per cow for being covered by a fine bull; who will send across the kingdom to distant provinces for new implements, and for men to use them; who employ and pay men for residing in provinces where practices are found which they want to introduce on their farms? At the very mention of such exertions, common in England, what mind can be so perversely framed as to imagine for a single moment that such things are to be effected by little farmers? Deduct from agriculture all the practices that have made it flourishing in this island, and you have precisely the management of small farms."

80,000 of the flower of the peasantry to serve three years in the army. That the effect of this latter upon the population is prejudicial to agriculture there cannot be a doubt, nor is it less injurious to the rural population in a social sense. Such has been the consequence of this draft, coupled with other circumstances, that not less than one-third of the men are rejected because they are incapacitated by disease or other imperfection for joining the ranks; and the standard height, too, has been repeatedly lowered because the race of men has degenerated, and they can no longer find a sufficient number at the former standard."*

We cannot but consider this conscription law as far more prejudicial to French agriculture than any of the former causes; and when we add to the whole the subdivision of the land, which fills the country with a multitude of cottier proprietors, who are too poor and too ignorant to cultivate the soil to the best advantage, and whose whole aim is rather to save by frugality than to expend their savings in improvements that would be largely reproductive, we can be at no loss in accounting for the backward state of agriculture in France, or the difficulty the government experiences in stimulating enterprise amongst the farmers.

Such is the general condition of agriculture in France as deduced from the admissions of one of the most intelligent and honest writers on the subject in that country.† With a soil and climate far superior to that of the British Isles, and with every facility and means of improvement by the application of natural and artificial manures to the modern system of husbandry—whilst the extent of arable and pasture land is nearly double that of England, France cannot supply her population with cereal food, even of the inferior kinds, which are most cultivated. The progress made in the most favoured districts is slow, and the adherence of the farmers to ancient modes of cultivation is with great difficulty overcome.

It is not denied that in some parts of France considerable progress has been made in agricultural improvements, and it would be strange indeed if it were not so, after all the efforts made by the government to promote it. The north-west region is by far the richest, being that in which the capital is situated, and reflects its wealth over the whole region by the large extent of its markets, and the influence of its intelligence and industrial establishments. The consumption of agricultural produce it creates is chiefly supplied by the surrounding districts, which are everywhere intersected with highways, railroads, canals, and navigable rivers. Forty-five per cent. of the whole public revenue of France is paid by this region. The department of the Seine, in which Paris is situated, although the smallest in extent of any in the empire, and not more than one-twelfth the average size of the regional departments, contains more than one-fourth of the population, and pays more than one-third of the taxes. This department, with that of the north and the Pas-de-Calais, are the most flourishing and best cultivated portions of France; this is due chiefly to the vicinage of the capital, but also to the manufacture of beet-sugar, for which the climate is peculiarly adapted. There are in the department of the north alone 340 beet-sugar works, to supply which 50,000 acres of that root are

* If there is any truth in the laws of physiology, this continual draft of the most healthy of the population for the army, leaving only the diseased, the feeble, and the diminutive to cultivate the soil, and sustain by procreation the species, the system pursued must necessarily deteriorate and diminish the population. Such is, in fact, the case: *the rural population decreases in number, and in physical strength*, as is proved by the census, by the lowering of the military standard, and by the rejection of so large a proportion of the peasantry by the conscription.

† De Lavergne.

annually cultivated. This Lavergne considers the masterpiece of rural manufacture, causing a collateral increase of cereal and animal produce, raising a large quantity of cattle food, and consequently of manure from the *megass* or refuse of the works. The rent of land ranges from £1 14*s*. in the rural districts to £2 11*s*. per acre in the neighbourhood of the large cities.

But these departments are under the operation of the small-farm system, which universally prevails, and is productive of an evil which detracts greatly from the admiration it would otherwise excite. The population amounts to 86·17 per 100 acres, half of which, or upwards of forty to the 100 acres, live by agriculture, whilst *one-third of the whole* are supported out of the public funds, a proportion greater than that of any other country in Europe. Lavergne sees no hope of reducing this pauperism but in reducing the population by emigration, there not being any employment for the surplus, notwithstanding the large manufacturing and other establishments spread over the different departments.

In the centre and the south of France the *métayer* system of tenure prevails; and destitute as they are of markets, or roads to convey the produce to a distance, no other mode of letting or occupying the soil is possible. That such facilities should not have been provided by the government, reflects deeply upon its policy. Whilst millions upon millions are expended upon the embellishments of the capital, and upon an army and navy that constitute a permanent threat to the neighbouring nations, no efforts are made to remedy the defects under which the rural populations of the distant departments are held in poverty and distress. The picture drawn by Lavergne of the mode of living of the *métayer* and his landlord is deeply affecting. "The cultivator," he says, "has little or nothing to dispose of; why does he work? To feed himself and his master with the produce of his labour. The master divides the produce with him, and consumes his portion; if it is wheat and wines, master and *métayer* eat wheat and drink wine; if it is rye, buckwheat, potatoes, these they consume together. Wool and flax are shared in like manner, and serve to make the coarse stuffs with which both clothe themselves. Should there happen to remain over, a few lean sheep, some ill-fed pigs, or some calves reared with difficulty by over-worked cows, whose milk is disputed with their offspring, they are sold to pay taxes."

The great misfortune of the rural districts of France is, that with the destruction of the seignorial system by the revolution, and the division and sale of the seignorial estates, there remained no landed aristocracy to reside amongst the tenantry; whilst the military aristocracy which succeeded it held agriculture, as well as all other industrial occupations, in utter contempt. In England, if the pictures of rural life drawn by Thomson, Akenside, and other poets, are highly coloured, they are in the main true, and give a faithful, though flattering, idea of the state of the peasantry in many parts of the country. What a contrast does this present to the description given of the peasantry by the French poet Bruyère, whose career was contemporary with Thomson. "We behold," said he, "throughout the country, a set of ferocious-looking creatures, both male and female, dark, livid, and scorched with the sun, attached to the land, which they dig and grub with an untiring pertinacity. Their voice has a resemblance to that of a man, and when they rise on their feet they exhibit a human countenance; they are in fact men. At night they retire to their dens, where they live upon black bread, water, and roots. They save other men the labour of sowing and reaping, and certainly do not deserve to be without that bread which they themselves have produced." M. Lavergne says, "this terrible description will ever remain as a cry of remorse from the Great Age,"—that of Louis XIV. The condition of the centre of France is not much better in the present day, if we may credit the accounts of those who have travelled there. A bad harvest is synonymous to them with a famine, for the *métayers* have nothing in that case to fall back upon, but, like the cottier farmers of Ireland in 1847, succumb at once to the calamity.

The military hierarchy, which succeeded the seignorial, is still the only aristocracy of France, and is as much opposed to rural life as ever. But few of them who possess estates ever think of residing upon them, and leave the management to their stewards or men of business. The moving principle of a French military man is national glory, and his great aim, to rise in the army, and obtain the notice and favour of his emperor. When, therefore, not in the camp or the field, the court, and not the country, is his resort. The revenue from his estate, if he possesses one, is spent far away from those who have contributed to it, consequently there is no sympathy between them. "The true ballast of the body politic—the salt of society, that which holds it together—is the country feeling. This feeling, no doubt, is of an aristocratic kind, but it is not aristocracy itself, for both may exist independently. British aristocracy has made common cause with the country feeling, and this is what constitutes its strength: French aristocracy holds itself aloof from it, and herein lies its weakness. In England, the country life of the upper classes has, in the first place, produced energetic and high-minded habits, out of which the constitution has taken its rise; and then, owing to these very habits, liberty has been prevented from running into excesses. The liberal and conservative element has been wanting with us in France. In our own day, as formerly, absenteeism has effected, even in a political point of view, nearly all the mischief; and this is the reason why these two apparently distinct causes of prosperity—liberty without revolutions, and the country feeling—are really but one."*

The system of agriculture in the southern departments of France is different from that of the north and centre, being adapted to the soil and climate. The produce is chiefly maize, vines, mulberry-trees for the silkworm, and olives. These of course involve a totally different species of culture from the cereal and root-crops which are produced in the north. The beetroot cannot be grown at all to advantage—the proportion of saccharine it contains decreasing, the further it proceeds south. They have, however, as a substitute, the sorgho,† which yields as large an amount of sugar in the south as the beetroot in the north, and a considerable quantity is cultivated for that manufacture. The climate is intensely hot and dry in summer, and the crops of grain frequently suffer from drought, which, however, is favourable to the vine, the olive, and the maize. The Rhenish departments are considered the most thickly populated and closely cultivated of any part of France except the Nord; but the subdivision of the land has reached to such a degree as to cause extensive emigration, and the authorities have become alarmed for the consequences. The entanglements of the numerous properties, which consist of diminutive slips of land in open fields, intermixed with each other without the slightest regard to proximity of individual ownership, has become so embarrassing and obstructive to agriculture, as to call loudly for a change; but what that change should be, is a subject of controversy. Whatever is done, it is evident that unless an entire alteration

* De Lavergne, "Rural Economy of England," &c., p. 149.

† Sorghum Saccharatum.

is effected in the law of succession, any modification can be only a palliative, which it will be necessary to repeat after a few more years.

In the meanwhile, the competition for land is so great that the most extravagant prices are given for it, and in the neighbourhood of towns it has brought as much, in some cases, as one hundred years' purchase. This is especially the case in the wine districts of Burgundy and the adjoining parts, where most of the properties are excessively small and, formerly, profitable; but the disease which has attacked the vine for some years past, has greatly impoverished the proprietors as well as deteriorated the produce. Indeed, many of the wine-growers of that fertile district have become so despairing of any beneficial change, that they have displaced the finer types of the vine, which they formerly cultivated, by the introduction of a more hardy, but greatly inferior species. This may possibly be the means of stopping the disease, but it will materially affect the character of the produce of the district, which formerly was held in such high estimation.

SECTION V.

PRUSSIAN AGRICULTURE.

The systems adopted by many of the continental governments since the era of the French revolution, and, amongst the rest, by Prussia, are both anti-progressive in regard to industrial pursuits, and revolutionary in their political tendency. With the latter effect we have nothing to do, otherwise than to show how they hinder the advancement of agriculture, their chief bearing being upon the land and that portion of the population connected with it. In speaking, therefore, of the agriculture of Prussia, it is impossible to avoid referring to those political circumstances which, we believe, retard or promote, as the case may be, the improvement of the soil, and the increase of its productive capacity.

The subdivision of the land had long before been introduced into Italy and many of the smaller continental states. We have already endeavoured to show the effect produced by it in France and Ireland; in the former of which it is peremptorily provided for and enforced by legislative enactments; in the latter, by long custom. Prussia has been one of the last to adopt it, and we shall endeavour to show that its influence is not less marked in that country than it is in France.

At the commencement of the present century, the Prussian government found itself deeply involved in the wars of Napoleon, which, in their progress, threatened the very existence of the nation. At that period the feudal system prevailed in that country in all its rigour, the land being chiefly divided into large baronial estates or seignories, belonging to the nobles. The rural population were serfs or slaves, having no political or social rights, but subject to the uncontrolled authority of the seigneur, who possessed a complete jurisdiction within his seignory, and virtually the power of life and death over them. It is true the serf had the right of appeal to the sovereign in case of injustice on the part of the lord; but this was attended with such difficulties as to render it almost a dead letter. But whilst on the one hand they belonged to, and were part and parcel of, the estate, which they could not leave for a day without the sanction of the lord, and were liable to be sold like the cattle with the land as a part and parcel of the personal property, on the other, they possessed a tacit, customary, and hereditary right in the soil to a certain extent, of which the seigneur could not deprive them. By virtue of this right, they held a small portion of land for which they paid a rent *in kind,* and performed a certain amount of labour on the domain, with other services. Whilst these were performed, the seigneur could not eject them from their holdings, nor deprive them of any property they might acquire.

Such was the condition of things in Prussia when the state of active warfare in which that country became involved with France rendered it necessary to bestow upon the masses of the population a more free and direct interest in the soil, in order to induce them to make greater exertions in its defence. The Prussian government therefore determined upon the emancipation of the serfs, and a distribution of the land in small quantities amongst them, so as to give them a stronger and more personal interest in the protection of the country.

Another motive, however, influenced the sovereign in this decision; this was, to break down the power of the landed aristocracy, which, at times, had been found troublesome when opposed to his wishes. The object, therefore, was to render the government more despotic by centring the power in the hands of the sovereign, who threw himself, by the measure, upon the masses of the people.

It was in 1807 that decrees began to be issued for the purpose, by virtue of which the feudal system was abolished, the whole of the rural population made free from serfdom, and the lords of the soil—the landed aristocracy of the kingdom—compelled, on certain conditions, to transfer to them a share, in perpetuity, of the land; in some cases, on payment of a fixed sum, either down at once, or by instalments, security being given for such payment. But although the decree was compulsory on the lord, it was made optional on the part of the peasant; and, in the first instance, many of them who were under liberal and kind masters, to whom they were attached, preferred to continue upon their old tenures. We believe, however, that such cases were rare, and that there are now very few remaining, if any, who have not availed themselves of the law to become freeholders. The decrees by which this great change in the policy of the Prussian monarchy and in the condition of the peasantry was effected, were completed in 1811.

This measure was but a first step in elevating the moral and material condition of the rural population of Prussia, and by which, nominally at least, they acquired a political existence and position in the state, as occupying to a certain extent the place of the ancient aristocracy. They thus became the most important element of the social body; but the government, unwilling to surrender any portion of its own power, whilst it annihilated without scruple that of the landed proprietors, shrank from taking the next step—of granting to the people the constitution which was promised to them at the Congress of Vienna in 1815. Freedom from local oppression was bestowed, and the means of subsistence by their own free labour; but *political* freedom was still withheld, nor were they invested with political influence in any form whatever. No representative legislature, no voice in any measure proposed by the government. In the place of the ancient aristocracy, a numerous body of new functionaries was created, whose interference in all the arrangements of social life are quite as onerous, and far more annoying, than that of the former lords of the soil. Every social institution, every civil appointment, even every domestic movement of the people, are under the surveillance of the police, and, thereby, the control of the government, in which is centred the entire power over the whole political, civil, and social affairs of the nation, uncontrolled by, and irresponsible to, any jurisdiction whatever.

But the Prussian government did not confine itself to the change we have referred to, nor deem the power it had acquired over the masses of the people a sufficient safeguard to the crown and the country. The kingdom of Prussia is composed of various states, each of which possesses a language, a nationality, and habits of life of its own, and, consequently, between them there is but little sympathy. The war with the first Napoleon had taught the government of Prussia its weakness, and the necessity, if it could not create a national feeling amongst the several sections of the kingdom, of endeavouring to amalgamate them in a military organization for the national defence. The conscription law, adopted in France by the republic in 1792, and continued by the successive governments that succeeded it, by which 80,000 of the male population were annually enrolled in regiments of the line, suggested the necessity of a similar measure to prepare the kingdom against whatever contingency might arise. With the twofold object, therefore, of national defence against a dangerous neighbour, and the desire of uniting as far as possible the discordant elements of which the Prussian dominions were composed, the *landwehr* was determined on. As the operation of this institution has a most material influence on the general, and an especial one on the agricultural, industry of the country, we shall explain its nature.

By the decree for the formation and permanent continuance of the *landwehr*, every male inhabitant of Prussia, whatever may be his rank, wealth, station, profession, or calling, is compelled, when between the age of twenty and twenty-five years, to serve for three years in a regiment of the line. This system was established by decrees of the 3rd of September, 1814, and the 2nd of November, 1815; and such is the rigour and impartiality with which it is enforced, that nothing but the most obvious incapacity of body or mind, from natural or accidental causes, can procure exemption. Every conscript undergoes an examination by a local board of commissioners for military affairs, whose proceedings are reported to, and narrowly watched by, a superior provincial board; and both report upon every claim to exemption, to the war department. Such is the construction of these boards, that no favour or partiality can by any possibility be secretly exercised without detection; nor can any local interest screen an individual from his turn for entering the army for three years, which is determined by lot, drawn by those who are between the prescribed ages, as stated above. Each conscript is appointed to a particular branch of the service, and to a certain regiment, determined by his height, constitution, or previous occupation. Officers from each department of the service attend the boards at their sittings to regulate the selection. In special cases, in which so long a service as three years would be destructive or highly detrimental to a person following a particular profession, the period is shortened to two or one year, upon a certificate of the facts being given and the party finding his own clothes and accoutrements. Such instances, however, are very rare and exceptional, and cannot be claimed as a right, being entirely at the discretion of the higher authorities.

After the three years have passed, and the conscript has completed his service in the army, he returns home on leave of absence, not absolutely as a civilian, but as a supernumerary, and is liable to rejoin his regiment in case of a war. On reaching his twenty-sixth year he is discharged from the standing army, and is then attached to the army of reserve, or that division of it called *erster-aufgelboths*, or "first for service." This is considered the effective army of the country, being composed entirely of soldiers of three years' training, and between the ages of twenty-six and thirty-two years. One-third of the standing army is discharged every autumn into this division of the army of reserve, and is replaced in the spring out of the population, by the local and provisional boards of commissioners. The army of reserve is called out for exercise in field manœuvres for fourteen days every year, which, however, is sometimes extended to twenty-eight days. After the age of thirty-two, the conscript is turned over from this first to the second division of the army of reserve. In case of war, this division will not take the field, but will do garrison duty, as being composed mostly of men of families and more advanced in life; and also of half-invalids, who have been found unfit to serve in severe duty. After his forty-ninth year, the conscript is transferred to the *landsturm*, or *levée-en-masse*, which is only mustered or exercised in its own locality, and will only be called out in case of actual invasion or a popular tumult. The whole land is thus one vast encampment, the whole male population one vast army, every man, of whatever age, in whatever situation in life, or in whatever locality, being a drilled soldier, who knows his regiment, his company, his squad, his military place in it; and he appears under arms at his rendezvous, for duty, with as little delay or confusion, and as complete in all military appointments, as a soldier in any standing army quartered in cantonments.*

It is impossible to conceive of any national institution more directly subversive of industrial habits, or presenting greater obstacles to industrial progress, whether in commerce, manufacture, or agriculture, but particularly the last, than this of the *landwehr* in Prussia. Can it be doubtful what must necessarily be the effect upon these interests, to have the entire male population abstracted for three years from their industrial pursuits, just at that age when labour itself is a pastime, and its instruments toys in the hands of the workman? What, too, must be the effect on the moral character and habits of the majority of these young men, produced by incorporation with the regular army at that period of life when the mind is most susceptible of impressions, and the profession of a soldier, half spent in idleness and dissipation, and the other half in acquiring a taste for military life, is thus imperiously forced upon him for the whole of his existence? for such in point of fact is its real duration. Although necessity may compel the conscript, during the intervals of his military service, after leaving the regular army, to work for his bread, the dissipated and desultory habits of the guard-house and the camp will cleave to him through life; and independent of the time abstracted from the years of useful labour, his industrial qualifications themselves are deteriorated by those acquired in his military capacity.

Nor does the mischief stop here. The land being thus constantly deprived of the labour of the strongest and most efficient of its hands, is chiefly managed by the women, and those youths or men who are unfit for the army, and is consequently very imperfectly tilled; whilst the subdivision to infinity, by the same process that

* See Laing's "Notes of a Tour," &c.

prevails in France, presents the same bar of ignorance and poverty to the progress of improvement.*

The emancipation of the serfs or peasantry in Prussia is, therefore, nothing more than a change of masters effected by breaking up the ancient landed aristocracy, who were to a great extent independent of the crown, and the substitution of a military aristocracy, dependent upon, and under the absolute control of, the crown. The serfs, it is true, have been constituted freeholders upon the land formerly held by the seigneurs, but it was accompanied with the condition of surrendering to the crown their entire civil rights, and of being thenceforth governed, controlled, and overlooked by functionaries created, maintained, and commanded by the crown. Instead of a baronial master, who, whilst standing between the serf and the crown, might be supposed to have had an interest in the welfare of his retainers, these latter are now under the constant surveillance of a set of officials, who have no other interest to look to than that of giving satisfaction to the power that employs them.

So far as any social consolidation of the separate provinces of the kingdom is concerned, the system is a complete failure. The raw materials—if we may so express it—are aggregated, but not amalgamated; centralised, but not socialised. Composed of different and hostile provinces, conquered or transferred, each retains virtually its nationality and peculiarities in language, manners, and religion; and the government, which keeps them in unwilling subjection, has no hold upon their sympathies. "It is connected," says Laing, "only by two ties—that of the military army with its officers, and that of the civil army with its functionaries. The material interests of the people, even amongst themselves, are not amalgamated. There are no common interests, common laws, common religion, common voice in the legislature, for their common centre, uniting all."

Nor has Prussia been more successful in the attempt to raise her military power above that of the neighbouring states. All the second-rate German states have, of necessity, adopted the same principle, so that the effect has been that every government of Europe is compelled to maintain a war establishment in the midst of profound peace, not only to the exhaustion and embarrassment of its financial resources, but to the injury of every industrial interest, and throwing back the progress of civilization throughout Europe by the overwhelming predominance of the war spirit which it engenders and keeps alive. Far from being strengthened by thus endeavouring to raise her military power above that of her neighbours, Prussia is in reality weakened; whilst adding largely to her expenditure, her natural resources are undeveloped through the injury done to the industrial interests of the country, and by the demoralization of its population. With the danger arising to the crown itself by thus putting arms into the hands of a people of mixed nationalities, upon the affections of a large proportion of whom it has no hold, but rather the contrary, we have nothing to do here; our only object in referring to the subject being to afford a more extended view of the land system in Prussia, and the influences which retard the development of its resources.

In the year 1825 Mr. Jacob was deputed by the British government to visit the

* The entanglement of the land in Prussia had arrived at such a pitch a few years since as to call for a legislative measure to regulate it. 50,000,000 acres (the term used by Lavergne is *journaux*, which, in Fleming's and Tibbing's French Dictionary, is stated to be used instead of *arpent* in many of the rural districts of France: the *arpent* is an acre in some parts, and an acre and a half in others), the property of 1,600,000 proprietors, were thrown into masses, according to the districts, and the proportions awarded to each according to their separate claims.

provinces of northern Europe, for the purpose of ascertaining the state of agriculture in the grain-exporting countries. The system of the subdivision of the land amongst the rural population had been in operation eighteen years, so that a fair judgment might be formed of its effect both upon the character of the people, and upon the productive powers of the soil. This would undoubtedly have been the case had not the measures of the government in other respects been at variance with the benefits conferred upon them by the abolition of serfdom. We must, therefore, take the state of things as we find them, being unable to judge except by analogy, how far the low state of agriculture in Prussia is due to the system of small farming or proprietaries, or to the political causes we have described.

At the period of Mr. Jacob's visit there were in Prussia 314,533 estates under fifty acres in extent, and 257,347 of from fifty to 250 acres. There were also 668,400 adult male Prussians, some of whom had each a small house of his own, whilst the remainder were labourers for others, and did not possess either house or land, but were allowed by their masters the use of a field for the support of one or two cows. It was possible for the poorest young man, if intelligent, prudent, and self-denying, to purchase a farm or garden for himself.

Mr. Jacob, in his report, does not tell us the state of the land in Prussia in regard to the number or size of the farms, but is very explicit in speaking of the condition of the peasant proprietors, as well as of those who work for wages. Neither of these have their counterpart in any class in England. Their dwellings were built of boards, or of stone put together without cement, and covered with shingles; their food potatoes, rye, or buckwheat; their clothing is manufactured by themselves—the linen from flax or hemp grown on their own patches of land, their woollens from the fleeces of their own sheep. An earthen pot that would bear the fire was the most important article of furniture. The honey produced by their bees served as a substitute for sugar; chicory grown on their own land for coffee. Wood abounded everywhere for fuel, and was burned in close stoves. Water was the only general beverage, their means not allowing of either spirits or beer in common.

Nothing can illustrate the effect of the military system upon the agriculture of Prussia more strongly than the fact that the land is chiefly cultivated by women and girls, and that very few men are to be seen in the fields. The women are found in numbers performing every operation of husbandry, even to digging—the most laborious part—the men being either engaged in their military duties, or idling away their time amongst their comrades of the regiment. The account given by Mr. Jacob of the condition of the rural population is confirmed by Laing and other more recent writers. Without capital or agricultural knowledge, and having no remunerative labour to employ their spare time, the peasant proprietors have no chance of improving their condition.

The Prussian crown holds large landed property, which in Mr. Jacob's time was let out in large farms at rentals ranging from 8*d.* to 4*s.* per acre according to the quality. These crown tenants, however, do not appear to have been in much better condition or circumstances than the freeholders. Mr. Jacob states that they had allowed the rents to run in arrears for ten years, when the crown, finding that they were unable to pay the back rents, consented to waive its claim, on condition that they would pay in future. This they promised to do; but he states that it does not appear they had been able to fulfil their engagement.

Under such circumstances the cultivation of the soil was necessarily at a low ebb. The triennial system—a fallow and two crops of corn—was universally adopted, and the produce was necessarily small. The following is the amount, according to Mr. Jacob, of the actual return, in Pomerania, of the four principal grains: —

	Bushels.		Bushels.
Wheat sown	155,935	produced	996,224
Rye ,,	1,254,960	,,	4,383,584
Barley ,,	619,992	,,	2,757,688
Oats ,,	1,245,701	,,	2,975,880
	3,276,588		11,113,376

This gives a produce of only $3\frac{4}{10}$ of the seed sown of all kinds of cereals taken together, or separately—

Wheat	$6\frac{4}{10}$
Rye	$3\frac{5}{10}$
Barley	$4\frac{4}{10}$
Oats	$2\frac{3}{10}$

The value of land at that period was very low. Mr. Jacob speaks of one farm of 2,800 acres of good sandy loam, chiefly arable, which was sold whilst he was in the country for £5,300, or not quite 40*s.* per acre. Another farm of 4,200 acres of land of inferior quality, which was mortgaged for £3,000, was put up for sale upon a foreclosure, when it would not fetch enough to cover the mortgage, and the creditor was obliged to take it. This cost him little more than 14*s.* per acre; but being a wealthy man he could afford to expend £2,000 more upon it, and thus probably made it a more profitable, because a more productive, occupation than the former owner had it in his power to do.

Such was the value of land in Prussia in 1825, since which the system of subdivision has proceeded rapidly, without any change in the social or political condition of the country, to relieve the peasant proprietors from the heavy tax upon their time and labour, inflicted by the *landwehr.* The following was the distribution of the land in 1852:—

Farms of from 1 to 4 acres . . .	936,570	or	48·90	per cent.
,, ,, 4 ,, 19 ,, ...	565,354	,,	29·50	,,
,, ,, 19 ,, 189 ,, ...	382,515	,,	19·99	,,
,, ,, 189 ,, 378 ,, ...	14,020	,,	0·73	,,
,, above 378 ,, ...	17,003	,,	0·88	,,
	1,915,462 *		100·00	

The above statement, which is taken from the official accounts of the Board of Trade, exhibits an increase of more than 300 per cent. in the number of farms under 250 acres. The following shows the mode in which the land is appropriated :—

Gardens, vineyards, and orchards	892,079	acres.
Arable land	30,094,640	,,
Meadows	5,266,449	,,
Permanent pastures	5,419,192	,,
Forests	13,614,564	,,
Waste land	13,529,614	,,
	68,816,538	

* The Prussian statements are given in *morgens,* a measure to which we have nothing analogous in English. The *morgen* contains about 101 perches English measure.

The entire produce of the principal crops in the year 1851 was as follows :—

Wheat	3,674,063	quarters.
Rye	12,020 250	,,
Barley	3,600 000	,,
Oats	14 218,125	,,
Potatoes	52,593,750	,,

It is evident from the above table that wheaten bread forms no part of the common food of the Prussian people. Mr. Jacob states that from the time he left the Netherlands, in passing through Saxony, Prussia, Poland, Austria, Bavaria, and Wurtemberg, he never saw, either in the baker's shops, in the hotels, or at private tables, a loaf of wheaten bread. The only form in which it could be obtained was that of small rolls, and they were only seen when foreigners were at table. Since his time it has probably come more into use amongst the wealthy classes, but still the quantity consumed is comparatively small, the produce as stated above not allowing more than two bushels per head per annum for the whole population.

Nor does that produce admit of any exportation of wheat of Prussian growth. It is a well-known fact that the wheat exported from Dantzic, Konigsberg, and other Prussian ports comes from the Polish provinces of Russia and Prussia, where the land is good, and wheat is a principal crop. Rye bread is universally eaten, and, with potatoes and buckwheat, forms the principal food of the peasantry, meat being a luxury beyond their means. The following was the number of live stock, &c., in Prussia in 1849 :—

Horses	1,575,417
Horned cattle	5,371,644
Sheep	16,296,928
Goats	584,771
Swine	2,466,316
Wool 35,853,242 lbs.	

There were brought into cultivation between the years 1849 and 1852 2,768,880 acres of land previously waste, which was applied as follows :—

Gardens, &c.	68,228	acres.
Arable land	1,195,110	,,
Meadow	170,067	,,
Permanent pasture	192,299	,,
Forest	1,143,176	,,
	2,768,880	

From the statements given above, it appears that the farms under four acres amounted in 1825 to one half of the entire number, and they probably have considerably increased since. The available land, exclusive of the forests, may now be assigned in the following manner :—

936,570	farms averaging	$2\frac{1}{2}$ acres	2,341,425
565,345	,, ,,	10 ,,	5,653,450
382,515	,, ,,	60 ,,	22,950,900
14,020	,, ,,	250 ,,	3,505,000
17,003	,, ,,	500 ,,	8,501,500
			42,952,275 acres.

This, of course, is only an approximate division, there being no certain data on the subject. It is sufficiently near to show the relative extent to which the different grades of agriculturists hold the land. The table of produce is important as exhibiting the agricultural results. It should, however, be stated that the cultivation of the Silesian beetroot for the manufacture of sugar, and for distilling, is extensively followed in Prussia. In 1853 the quantity grown in that country and its dependencies, and consumed by the sugar factories alone, amounted to nearly 1,000,000 tons, which, reckoning the average produce at ten tons per acre, require an extent of 100,000 acres of land. The potatoes may be reckoned at twelve quarters or three tons per acre, which will make the quantity of land under that root 4,049,480 acres. The triennial fallow deducts one-third from the cultivated land, leaving 20,063,094 under crop. The entire produce of cereal crops amounts, in round numbers, to 33,500,000 quarters. If we estimate these at $2\frac{1}{2}$ quarters per acre we have an aggregate of 13,400,000 acres under cereal crops. The following is, therefore, the disposition of the arable land :—

Land under crop		20,063,094 acres.
Wheat, barley, rye, and oats	13,400,000	
Potatoes	4,049,480	
Beetroot	100,000	
Other produce	2,513,614	
		20,063,094 acres.

The above estimate of the yield of cereal crops appears small; but when, in addition to the drawbacks upon agriculture we have referred to, it is added that the land of most parts of Prussia proper is light and sandy, and that it is frequently subject to drought in summer, it will not be thought that the produce is understated. The most fertile and best cultivated part of the kingdom is the Rhenish district. A recent estimate published of the crops in those provinces makes the average produce of all the cereals amount to thirty-three bushels per acre, according to the following table :—

Wheat	26	bushels per acre.
Rye	26	„
Barley	35	„
Oats	48	„
Divided 4)	135	
Average	$33\frac{3}{4}$	bushels.

This, however, is an exceptional case, and does not represent the general yield of the kingdom. Mr. Jacob's estimate makes the return only $3\frac{4}{10}$ of the seed sown. If we average this at three bushels per acre it amounts to only $10\frac{1}{2}$ bushels per acre of all cereals, which is a little less than one-third the estimated return given of the Rhenish provinces. Since Mr. Jacob's time, however, great advances have been made in agriculture, through the exertions of the government, by instituting agricultural associations and shows. There is no doubt that the high price of grain the last few years, and its free admission into the United Kingdom at a nominal duty, has given a stimulus to agriculture in Prussia, as well as in other maritime states. Incredible exertions have been made in Prussia to stimulate the cultivation of the soil, and to improve the breeds of domestic animals, particularly sheep. In 1842 the "*Landes Œconomie Collegium*" was organized by the government; this is a consulting committee of agriculture, and has the right of initiating any propositions the interests of agriculture may require. This institution has been of essential service in establishing, and assisting in establishing, various associations and committees, and other leading measures, which have been eagerly responded to by the landed proprietors. Instruction in agriculture was first instituted by private individuals, but has been taken up by the government, and there are now four public agricultural institutions, namely, at Eldena, in Pomerania; Proskau, in Silesia; Poppelsdorf, near Bonn upon the Rhine; and Waldau, near Konigsberg, the ancient capital of Prussia. The following are some of the details of these institutes:—

	Date of formation.	Extent of cultivation in morgens.	Number of professors.	Government grants. Thalers.*	Number of pupils—1860.
Eldena	1835	1,605	5	4 720	50
Proskau . . .	1847	3,926	5	7,070	61
Poppelsdorf . .	1847	128	5	6,951	78
Waldau	1858	1,677	5	7,000	54

An important measure has been undertaken by the Prussian government at the close of 1860. We have already related the steps taken to emancipate the serfs and give them a portion of the lands formerly held by the seigneurs. This measure, however, was never fully carried out to a complete settlement of the conflicting claims between the emancipated serf and the seigneur. The cause of this delay is, that in order to avoid as much as possible the increase of the irritation the settlements might occasion, the arrangements were left in a great measure to the amicable agreement between the parties. When this could not be effected, the law ordained that the *métayer* having the hereditary beneficial occupation of an agricultural property, should render *one-third*, and he who had not such hereditary tenure, *one-half*, to the seigneur. These conditions might be executed either by a real surrender, in kind, of a third or half the land, or by holding that portion against an annual rent, payable in wheat or in money. A special office, employing numerous agents, was instituted to execute these arrangements, according to the views of the government.

At the end of 1858 this office had completed the following operations:—82,137 farms, comprising 5,471,629 morgens, were declared the property of the peasants who cultivated them; and 1,101,469 others had been freed from the onerous dues and services with which they had been burthened. The indemnity paid to the ancient proprietors had risen to 52,617,267 thalers (£8,171,414) in cash on the spot, a rent in money of 5,162,630 thalers (£756,661), and by a rent in kind, of 282,826 scheffels (53,030 qrs.) of cereals. 1,613,614 morgens of land have been surrendered. Apart from these operations relating to compact farms, they have purchased or liquidated the several charges, assessed upon 54,852,958 morgens of arable lands, meadows, pastures, forest, and commons. The fines in money have all been settled under the form of *letters of rent*, negociable, purchaseable, and destined to liquidation."†

The emancipation of the serfs, and the conversion of the class into freeholders, can only be considered as a first step in the progress of agriculture; and were there no influences of a counteracting nature existing, to act as a drawback upon the industry of the country, and prevent the rural proprietors from reaping the benefit of the change, we might expect that, in time, they would, like the ancient yeomen of England, become sufficiently enlightened to see the folly of adhering to antiquated systems of cultivation,

* The thaler is about 3*s.* 1½*d.* English.

† The above account of this important operation, which will effect the complete emancipation of the peasantry and of land, is taken from the French *Journal d'Agriculture Pratique* of April 20, 1860.

by which the soil is kept in a half-productive state. But the overwhelming operation of the political institutions of the country, by which the whole population is placed between two armies, civil and military, and subject to the rigorous discipline of both, while attached by constraint to the most powerful of the two; when every thought, word, and action of the peasant's life is subject to the scrutiny of these institutions, so that the mind, as well as the body, is, in the strictest sense, the property of the state; when the moral and social character of every individual is a stereotyped production of the centralized power and authority of the government; when, not content with claiming the youth as soon as he arrives at an age to serve in the army, the government takes charge of him from his infancy, superintending, by its own functionaries, his education, and giving the bias to his mind, and dictating the track in which his every thought must run during the entire course of his life;—how is it possible that, under such circumstances, any considerable progress can be made in a profession which requires habits of thought and of action, free from any extraneous influence to fetter and confine them to stereotyped rules?

But even these are not all the disadvantages under which the Prussian husbandman labours, and against which he has to contend. His time and energies are monopolised by the government to an extent that totally unfits him for the duties of his calling. His profession of a soldier, to which he is bound for life, interferes with every arrangement of his regular business to such an extent that, what with the harassing nature of his military duties, and the desultory habits of life created by them, the peasant loses all relish for his regular calling, and spends his time in idleness and dissipation, leaving the cultivation of the land to the females of the family.

Under such circumstances, the small properties of the peasants can barely produce sufficient to support existence. Even the produce of the Rhenish farms is raised at an expense that leaves but little profit for the cultivator. It is estimated at 69 fr. per hectare (or 23*s*. 4*d*. per acre), and this was under the English system of cultivation; and the narrator justly remarks, "What would this be if, instead of following the precepts of alternate cropping we have indicated, they had obstinately followed the ancient system of Charlemagne? . . . . The laborious life, therefore, of the peasants of Eifel was far from enriching them previous to the increase in the price of cereals, since the period that supplied the items employed in our calculations. . . . Who knows if, even during these last years, many of them have not found that the increased price of the little produce they were able to take to the market has not made up to them the loss in the deficiency of the harvest?"

SECTION VI.

AUSTRIAN AGRICULTURE.

Austria is now the only one of the great European powers (except England) that has not adopted the system of a subdivision of the soil amongst the peasantry as a principle of policy. A few of its dependencies—as Venetia, the Tyrol, and that which it has recently lost, Lombardy—have long been subjected to it, and in these it is still in full operation.

But in all the large northern states, Upper and Lower Austria proper, Hungary, Bohemia, Moravia, &c., the ancient feudal system prevails in all its force, with the exception of a few modifications; and the land is divided into large baronial estates, in part occupied by the owners, and in part let out to tenants.

Austria, as at present constituted, comprehends twenty provinces, several of which were transferred to her by the Congress of Vienna, in 1815. At the same period the ancient title of Emperor of Germany, of which the Austrian sovereign had been deprived by Napoleon, was restored to him; so that, in point of real political power and territory, the Emperor of Austria occupied as high a position as at any former period of history. This power, however, is based upon the greatness of his military forces, rather than upon the affections of his subjects or the real union of the discordant elements of which the empire is composed. The population, according to the most recent accounts, is stated to be 37,442,633, having increased ten millions since 1816. From this number the population of Lombardy must now be deducted, which will probably reduce it by nearly three millions. The following is the distribution amongst the provinces according to the census of 1852:—

POPULATIONS OF THE AUSTRIAN STATES IN 1852:—

Lombardy	2,670,833
Venetia	2,257,200
Bohemia	4,347,962
Moravia and Silesia	2,250,594
Lower Austria	1,494,399
Upper Austria	856,694
Istria, Gortz, Trieste	500,101
Galicia and the Bukovine	5,105,558
Hungary	11,000,000
Styria	1,003,074
Transylvania	2,182,710
Carynthia and Carniola	784,786
Dalmatia	410,988
Military frontiers	1,226,408
The Tyrol	859,250
The army	492,486
	37,443,043
Deduct Lombardy	2,678,833
Total	34,764,210

Agriculture in Austria is in a very backward state, no progress having been made in it during the last thirty years, if we except, to a certain extent, the archduchy of Austria proper, and a few of the southern provinces. Many causes, to which we shall have occasion to refer, have contributed to this, not the least of which is the stringent protection granted to the native manufacturers of machinery, amounting to a prohibition of foreign-made implements and instruments of husbandry. This compels the farmers to purchase them at the dearest market, and of inferior construction; whilst the continual interference and supervision of the government officials in this, as well as every other industrial occupation, is of itself sufficient to account for the backward state in which agriculture is now found in Austria.

The entire extent of the Austrian dominions is comprehended in an area of 300,000 square miles, or 192,000,000 statute English acres. Of land capable of cultivation, there are 255,226 square miles, or 163,344,640 acres, of which 208,570 square miles, or 133,484,800 acres, are actually appropriated in the following manner:—

	Square miles.	Acres.
Arable land	91,300	58,432,000
Gardens, &c.	3,040	1,945,600
Vineyards	4,090	2,617,600
Meadows	18,390	11,769,600
Permanent pastures	18,530	11,859,200
Forests	73,220	46,860,800
	208,570	133,484,800

The following is the comparative per centage of cultivated land of Great Britain, France, and Austria:—

	Gt. Britain.	France.	Austria.
Land under tillage	34	44	34
Vineyards, orchards, gardens, &c.	1	5	3
Grass land	40	14	17
Forest, plantations, copses, &c.	5	17	26
Uncultivated	20	20	20
	100	100	100
Comparative population per square mile	220	165	130

The aggregate produce of cereals is variously estimated by Austrian statisticians, so that much dependence cannot be placed upon them. The following are the estimates of the most eminent writers on the subject:—

ESTIMATES OF THE CROPS OF WHEAT, BARLEY, AND OATS IN AUSTRIA BY VARIOUS AUTHORITIES.

Lichtenstein	36,134,000 qrs.
Blumenbach	43,640,000 „
Stein	45,820,000 „
Hassell	76,300,000 „
Malchus	88,070,000 „
Other writers	93,600,000 „

It is considered by those best acquainted with Austrian agriculture, that Malchus is the most reliable authority of any of the above. According to him, the proportions of the produce of wheat, and the inferior cereals, are as follows:—

Wheat	38,080,000 qrs.
Barley and oats	49,990,000 „
	88,070,000 „

The quantity of seed sown to produce these results he estimates at 17,820,000 qrs., which allows a return of about $4\frac{3}{5}$ of the seed sown, taking the three cereals together. The consumption of bread-corn amounts to 32,280,000 qrs., which allows six bushels, three pecks, nine pints per head for the whole population.

Maize is extensively cultivated in Hungary, Galicia, Bohemia, and Lombardy. The quantity produced is upwards of 5,000,000 qrs. Rice is also an object of attention in the islands of the Adriatic around Venice, and many millions of quarters are produced. Tobacco is raised in most parts of the Austrian provinces; but the finest quality of that weed is grown in Hungary. The entire quantity grown is about 35,000 tons, nearly one-half of which is Hungarian.

Most of the Austrian provinces are well provided with natural pastures, many of which, on the banks of the mountain streams, are very rich and fertile. But the number of animals kept upon them is by no means adequate to the extent and excellence of the pastures, being estimated as follows:—

Horses	2,110,393
Horned cattle	10,495,456
Sheep	30,000,000
Mules and asses	59,000

The best horses are bred in the Bukovine and Transylvania, where the Turkish races are generally kept. The Hungarian horses are light made, swift, hardy, and durable. Those reared in Moravia and Bohemia are chiefly of the heavy cart breeds.

The finest races of horned cattle are bred in Hungary, Transylvania, Lombardy, and Styria. In other parts, the native races prevail; but the breeders are beginning to cross them with others from Switzerland, Belgium, and other places. The price, however, of butchers' meat is so low, that it holds out but little encouragement to the graziers to give much attention to the subject, the chief inducement to keeping them being the raising a quantity of manure. In the purchase of cattle, the buyers look more at the size than at the quality of those they select, and pay but little regard to race.

The rearing of sheep has been long the subject of special attention, both with the landowners and the Austrian government. In the year 1761, during the reign of Maria Theresa, the Merino breed was first introduced into Austria upon the imperial domains of Mannersdorp and Hollitsch. The barons of Silesia, Moravia, Bohemia, and Hungary followed the royal example, and became extensive flock-masters. Powerful efforts were made to extend the breed, both of Merinos and the best of the English types. The most active and eminent of those engaged in the enterprise were the barons Bartenstein and Ehrenfels, Count Wrbna, Prince Lichnowski, counts Colloredo, Mansfeldt, Hemyade, and Karoly, and Messrs. Christian, Andrée, and Bernard Petri. These influential persons contributed largely to extend the breed of Merinos, which from that time became the most important agricultural product of the empire, and "the choicest jewel in the Austrian crown." Some of the nobles still possess immense flocks of sheep. About the year 1808 or 1809, the writer was at Holkham sheep-shearing, when Prince Esterhazy was also present, who, in an after-dinner speech, referred to the large flocks kept in his country. On being asked the number of his own, he said he could not tell within a few thousands; but he offered Mr. Coke a bet of £10 that he had more shepherds on his estate than Mr. Coke had sheep on his farm. The wager was accepted, and upon writing to his steward for the necessary information, the prince gained it by *one* shepherd over Mr. Coke's flock. The prince (for he is still alive) can travel sixty miles in a straight line from Vienna on his own land, and his present flock consists of 260,000 ewes, besides lambs. At that time, it was upwards of 200,000—the sheep, with their wool, being considered the most convertible produce of the soil.

Less attention, however, has been paid to sheep of late years, owing to the minds of the landowners having been diverted into other channels, as we shall presently have occasion to show. Since 1848, too, owing to the unsettled state of the empire, both cattle and sheep have declined in numbers and quality. But the recent advance in the price of wool has again given a stimulus to the breeding of the latter, and the farmers and large proprietors are directing their attention to the breeds of fine woolled sheep. On the other hand, the high price of all kinds of animal food in France and Prussia, in consequence of the increasing subdivision and *morcellement* of the land, which operates against the breeding and feeding of live stock, is likely still further to promote these objects in Austria, especially now that railways are established in the latter country, offering new facilities for the transmission of live cattle and sheep to all parts of Germany, as well as to France.

There are two peculiarities connected with the agriculture of Austria of sufficient importance to demand special notice, as having already exercised a powerful influence upon its welfare, and being likely to affect it hereafter in a still greater degree. These are, the establishment on all the large estates of works for the manufacture of sugar from the Silesian beetroot, and others for the distillation of spirits (alcohol) from grain or potatoes.

The first of these—the manufacture of sugar—had obtained a firm footing, both in France, as we have already shown, and in most of the continental states from the commencement of the present century; so that, without going again into its history, we may state that, in the year 1853, the number of sugar-works, and the quantity of beet consumed, was as follows:—

	No. of works.	Beet, in tons.
Prussia	181	16,383,235
Its dependencies	85	2,358,412
Bavaria	5	385,107
Saxony	4	159,440
Wurtemburg	4	628,763
Baden	2	1,150,789
Electoral Hesse	4	82,898
Thuringia	4	155,594
Brunswick	8	766,101
Frankfort	1	27,510
	298	22,067,849

The sugar produced from it was 1,540,560 cwts., which allows an average yield of 7 per cent. of crystallized sugar, independent of the molasses and *megass*, or residue, both of which are valuable items in the account.

In was in the year 1830 that the first sugar-works were established in Austria. They were erected by Prince Oettengen-Wollerstein, on his estate at Kleenkerchel, near Prague. About the same period other factories were established by Baron Stratendorf at Bedeskau, in Bohemia; Prince Latour and Taxis at Dobrobit; Count Czernin at Sudkal, Bohemia; Count Colloredo Mansfeld at Stacy, in Lower Austria, and some others of less note. Between 1830 and 1840, 115 factories were erected; but many of these being on too small a scale to be profitable, they were, as was also the case in France, abandoned. A few years since the number was reduced to 108, which consume annually 303,170 tons of beetroot, from which is extracted 137,380 cwts. of crystallized sugar, 182,100 cwts. of molasses, and 30,316 tons of residue. The latter is employed in fattening cattle and swine. The quantity of land occupied in this culture is 13,000 hectares (31,687 statute acres), which allows an average produce of nine tons per acre. The price of the raw beetroot varies from 19*s.* to 30*s.* per ton; the prices of the produce at the factory average about as follows:—

	£	*s.*	*d.*	
Crystallized sugar	3	0	0	per cwt.
Molasses	0	5	2	„
Residue	0	12	6	per ton.

At these prices, the original cost of the raw beet is about tripled, and an ample profit is realized by the manufacturer. It is estimated that the residue and the foliage of the beetroot, which latter is also economised at the continental sugar-works, are sufficient to maintain 6,500 oxen of the average size. Upwards of 20,000 persons are employed in this manufacture during the five winter months, when out-door employment is almost at a stand in northern Germany, and it is likely to be still further extended, having, at present, scarcely been introduced into Hungary, Galicia, Croatia, or Sclavonia. It is a question, however, whether it would pay the manufacturer in any latitude below 45° N., it being well understood that the proportion of saccharine decreases as it approaches the south. In the south of France it has been wholly abandoned on that account, the yield of sugar not being large enough to afford a profit.

We shall next give an account of the introduction, development, and effects upon the rural economy of Austria of the principle of agricultural distilleries, by which, as well as by the beet-sugar movement, the two branches of industry — agriculture and manufacture—have been united. Both took their rise under the same circumstances, namely,—the long continuance of extreme low prices of all kinds of agricultural produce in the fifteen years succeeding the peace of 1815, with the exception of two seasons, when the large deficiency in the cereal crops of the Continent rendered the advance in prices unavailing, so far as the profits of the growers were concerned. The ancient and close connection between distillation and husbandry, directed the attention of the great land proprietors to this branch of industry as a last resource for the disposal of the produce of the soil.

In many respects, Austria, as an agricultural country, was more unfavourably situated than either France, Prussia, or Russia, in that she had no outlets for her produce near to, or convenient for, the great markets of Western Europe. Trieste, at the head of the Gulf of Venice, and the Danube, are the only channels of egress by water she possesses; and at the period to which we refer (1830) there were no railroads in Germany, whilst the wretched condition of the public roads, and the great distance it would have been necessary to traverse to get the produce to a good market, were insuperable obstacles—especially when low prices prevailed for a length of time—to an export trade of any value to the landed interest. Both by land and water, therefore, her corn and cattle growers were shut out from the disposal of their produce when its value sunk below a certain ratio. Such was the case up to 1830, after the peace, when the establishment of agricultural distilleries was determined on as the only alternative presenting itself likely to preserve the value of the estates, by affording a means for a profitable disposal of the produce.

At the present time there are about 16,000 distilleries in the Austrian dominions. These were, we believe, at first, employed exclusively in distillation from grain; but as the price of cereal produce advanced throughout Europe, it was found more profitable to employ potatoes, on account of the comparative largeness of the acreable yield. The quantity of the tubers consumed, according to the statements from which we quote, amounts to 1,250,000 tons annually, which at the rate of three tons per acre, would require an extent of land of 416,666 acres. The quantity of raw spirit extracted from them is 63,828,039 imperial gallons, being 20 per cent. of the raw material. The residue amounts to 162,203,028 gallons, which is employed in fattening cattle and pigs. It is estimated that the above quantity will feed 60,000 head of cattle of the average size, the dung from which will manure 41,968 acres of land. This, however, falls far short of the quantity of land employed in the cultivation, as stated above; and it is therefore evident that the manufacture must be exhausting and deteriorating to the soil without a large outlay for other manure.

It is assumed by the advocates of the system, that these two branches of manufacture have alone saved the landed interest of Austria from utter ruin, and the soil itself from being abandoned to sterility. Whatever might have been the case in 1830,—and it is admitted that the state of the country was one of great difficulty with the agriculturists,—it was the same in other countries as well as Austria; and we rather fear that, eventually, it will be found that the effects are injurious both to the agriculturists and to the country at large. That the distillation is profitable is evident; and, so far, proprietors are benefited, whilst the labouring peasantry are furnished with employment. But that agriculture will suffer from the exhaustion of the soil, and by the diversion of capital and land from the cultivation of green and cereal productions is equally clear. Nor is it less unfavourable to progress and improvement in agriculture, that the mind and attention of the husbandman is divided between two incongruous occupations, which, although dependent one on the other for success, were never intended to be united. The proof of the correctness of the opinion that the soil will be deteriorated, is found in the small return of $4\frac{2}{3}$ of the seed sown, of the three cereal crops (wheat, barley, and oats), and the inattention paid of late years to the breeding of cattle and sheep. The temptation of an immediate market for the potatoes and beetroot has led the farmers to neglect other and equally important cultures, to the destruction of good farming, and, consequently, to the material interests of the country.

Nor is it true that the alternative adopted by the land proprietors of Austria was either the only one or the best that was left to them. It cannot be that the owners and occupiers of the rich and generous soil of Austria could be permanently reduced to such a condition as not to be able to derive subsistence from it, were there not other circumstances of a social or political nature operating against them. The soil is not so sparing of its gratitude to those who do it justice, as to refuse to the labouring husbandman the due reward of his toil. Unfavourable seasons may and will thwart his efforts and reduce his profits, as is the case with all industrial employments; but that where the proper means are used for cultivating the soil, it cannot permanently refuse or cease to yield a profit to the cultivator in so populous a country as Austria is a self-evident proposition. Had the same capital, too, expended in the erection and working of the 16,000 distilleries, been bestowed on improvements of the land, and in the purchase and breeding of superior races of animals on the rich pastures of Austria, the value of the estates would have proportionately increased, the returns of produce doubled, and the general results been infinitely more beneficial to the country at large.

This will be still more manifest if the effect on the moral and physical condition of the rural population is taken into the account. The consequences of having a manufacture of ardent spirits on every estate or large farm in the country, the proprietors of which have a direct interest in endeavouring, by all the means in their power, to increase the local consumption of the product, is necessarily calculated to create first a taste, and then a thirst for it; and such has actually been the case in Austria. With the view of disposing of as much of the alcoholic drink as possible *on the spot*, the distiller sells to the farmer *on credit*, to be paid when the crop of potatoes is ready for sale, out of which, he, being the only purchaser, pays himself by deducting the amount of the credit from that of the crop. The peasantry are also enticed by the spirit-dealers, who abound in every village and hamlet, to expend with them their earnings. The consequence is, that the whole rural population of the country, both farmers and labourers, have become addicted to the habitual use of ardent spirits, to the debasement and deterioration of both bodily and mental powers, as will readily be believed by those who are acquainted with the common effects arising from an habitual resort to alcoholic liquors. Such a result is inevitable in all cases, and Austria at this moment presents a melancholy illustration of it on a gigantic scale. "As to the consequences," says a late writer, in speaking on this subject, "as to the moral and physical consequences of the immoderate use of brandy, *they speak for themselves*. Galicia exhibits examples which deserve to be studied; and they have been amply exposed and brought to light, in the publications of those writers and temperance societies which have undertaken to struggle against the use of alcoholic liquors."*

That a greater attention to the improvement of the soil and the rearing of cattle and sheep in Austria would, in the end, be equally remunerative and far more beneficial to the country, cannot admit of a doubt. The supply of butcher's meat in Austria is much below the demand, and it requires a large importation, amounting to one million sterling, to make up the deficiency. The impolicy of thus depending on a foreign supply, abounding, as Austria does, in pastures of the richest description, is evident. Even the breeding of horses is very little attended to, and the selection of stallions and mares, with the exception of a few spirited instances to the contrary, is made without any regard to excellence of race. The same indifference is displayed in the choice of breeding cattle, the native races being still generally adhered to, although very inferior in symmetry and quality of meat. The breeders are said to be guided in their choice by size, rather than by excellence in other respects.

After the outburst of revolutionary feeling in 1848, the Emperor of Austria considered it politic to make some concessions to the wishes of the landed interest. One of the most important of these was the abolition of the *corvée* or statute labour, which pressed heavily upon the industry of the farmers, whose services were demanded at those periods when their labour was most needed on their own land. The increase in the value of agricultural produce of every kind, coupled with this concession of partial freedom from feudal service, has stimulated cultivation, and given rise to the establishment of various manufactories of implements and machines of husbandry at Vienna, Prague, Pesth, Limberg, Gratz, Andutz, Hohenmausen, &c. The threshing machine has superseded the flail, and the drill, hand-sowing, in the more advanced districts: the native plough, too, has been exchanged for one of modern construction; in short, all the modern instruments of western Europe are gradually finding their way into the rural economy of Austria. But whilst, as is the case, the cultivators consider a regular and improved system of tillage ruinous to their interests, it is impossible that any effectual progress can be made; and the chances against it are still further increased by the general opinion that the prosperity of the landowners depends upon the upholding a domestic manufacture that has already proved destructive alike of the moral and physical welfare of the people, and of the productive powers of the soil, whilst it absorbs the capital that might otherwise be beneficially employed in agricultural improvement.

* Eugene Marie.—See "*Journal d'Agriculture Pratique*," August 5, 1857.

SECTION VII.

THE AGRICULTURE OF THE GERMAN UNION.

THE German Union is one of those political combinations forced upon weak neighbouring states for the general safety of the whole body, or of individual members of the confederation, against the aggressive attacks of the greater powers. Yet there are elements in German politics that render it doubtful whether, in case of such aggression on the part of any one of the great European powers, the Union could be maintained in its integrity; or whether, at the first hint of war, it would not, as in the time of the first Napoleon, yield at once to the pressure of circumstances; and each state, guided by self-interest, or self-preservation, decide, as policy dictates, to remain neuter, or even to join the strongest party. The discordant elements of which the Union is composed, have too many individual interests to allow them to act in perfect harmony against what ought to be viewed as a common danger; and those which, by their geographical position, may be the most exposed to the ravages of an enemy, would probably be the first to endeavour to propitiate the aggressor by deserting the Union and allying itself to the enemy.

This constant anticipation of war, and the necessity of being prepared to repel an attack, is the great drawback upon the industrial institutions of the continental states, and especially that of agriculture, which depends so much for its success and progress upon the undisturbed efforts and energy of the rural population. The maintenance of military establishments, of enormous magnitude, in times of profound peace, involving the compulsory service of the whole, or of a large portion, of the male rural population, in order to prepare them for war, is only second, in its consequences on industry, to a state of actual warfare. Pity it is, that the great powers of the Continent cannot see that the true interests of the people are best secured by the continuance of peace, and that the reduction of those immense armaments which modern policy has reared, would be the surest means to promote the progressive prosperity of their kingdoms.*

The German Union, as at present constituted, comprises thirty-five sovereign states, two of which, Prussia and Austria, we have already had under review. The largest of those yet to be considered are Bavaria, Saxony, Wurtemburg, Mecklenburg Schwerin, Hanover, Holstein, Baden, &c. The following is the extent of profitable territory of each, according to the most recent authorities:—

States.	Under tillage.	Meadows.	Garden.	Wine Land.	Woods and Forests.	Totals.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Austria	15,322,812	5,217,162	326,110	413,732	15,850,837	37,130,653
Prussia	18,887,581	8,074,151	493,958	38,421	8,866,652	36,360,763
Bavaria	8,326,641	2,589,024	213,859	79,487	5,622,170	16,831,181
Wurtemburg . . .	2,448,859	686,369	94,682	64,347	1,493,864	4,788,121
Baden	1,444,628	391,129	34,696	51,307	1,227,641	3,149,401
Electorate of Hesse .	879,228	256,757	447,906	788	948,153	2,532,832
Grand Duchy of Hesse	976,564	266,851	365,895	23,341	685,107	2,317,758
Nassau	433,396	121,123	4,415	9,462	493,327	1,061,723
Saxoner	1,839,939	412,578	104,090	4,415	1,131,121	3,492,143
Carried over . .	50,559,648	18,015,144	2,085,611	685,300	36,318,872	107,664,575

* In the year 1850, the regular armies of Europe amounted to 3,139,823 men, but they have been largely increased since then. France, for instance, had only 265,463 soldiers, but has now between 600,000 and 700,000 under arms.

States.	Under tillage.	Meadows.	Garden.	Wine Land.	Woods and Forests.	Totals.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Brought forward	50,559,648	18,015,144	2,085,611	685,300	36,318,872	107,664,575
Weimar	494,944	81,380	18,294	473	225,214	820,305
Coburg Gotha . . .	278,837	34,696	7,570	. .	140,049	461,152
Altenburg	212,597	23,972	10,724	. .	66,239	313,532
Meinengen	249,187	43,528	13,247	. .	226,476	532,438
Hanover	2,752,413	1,606,154	168,438	. .	1,302,084	5,829,089
Brunswick	240,030	74,440	15,771	. .	299,655	629,896
Oldenburg	464,939	155,190	27,126	. .	232,099	879,354
Mecklenburg Schwerin	2,242,261	287,038	40,374	. .	372,834	2,942,507
Mecklenburg Strelitz	425,826	43,528	7,570	. .	135,633	612,557
Luxemburg	281,360	61,823	10,093	1,716	199,294	554,286
Limburg	152,666	164,022	8,210	. .	32,804	357,702
Holstein	1,463,793	316,688	25,234	. .	167,807	1,973,522
Lauenburg	173,484	29,650	4,418	. .	29,650	237,202
Other States . . .	1,186,636	237,210	35,327	1,198	592,727	2,053,098
Totals . .	61,178,621	21,174,463	2,478,007	688,687	40,341,437	125,861,215

The best cultivated states are Holstein and Mecklenburg, where the improved system of husbandry is practised. After these come Hanover, Brunswick, Bohemia, Saxony, &c. In Swartzburg, Reuss, Prussia, Bohemia, and Saxony there are extensive manufactures of woollen cloths, which employ a great portion of the populations. In Mecklenburg the land is chiefly divided into large farms, some of them containing 2,000 acres. These are laid out in five or six fields, each of which is wholly sown with one kind of grain, alternately. In Wurtemburg, on the contrary, the soil is subdivided into small properties, many of which do not contain more than from four to sixteen perches each. These are rather gardens than farms, and the occupiers, whether proprietors or tenants, are too poor to attempt any improvements, nor, indeed, can there be much room for it. Nearly three-fourths of the Germans are employed in agriculture, the major part being small owners of the land. These live in a far inferior condition to that of the English or Scotch labourer: their chief food is rye or buckwheat bread, and potatoes, no animal food ever falling to their share. No German peasant can hope to rise above the *caste* to which he belongs. He may acquire property, and frequently does so; but the possession of wealth can give him no title or privilege beyond that of using his money for his own benefit; nor does it raise him in the social scale, or add to his political influence or character. He cannot interfere in any political question, however deeply he may be interested, nor take part in any of the national movements of the day. His existence, as a member of the body politic is a blank, and his function in the state is limited to his physical capabilities as a soldier, to which occupation he is inevitably destined, after arriving at a certain age, as we have already shown in the case of Prussia. Any strong expression of opinion on political affairs, whether by word of mouth, or writing, or printing, would assuredly bring the delinquent under the ban of authority, and be followed with condign punishment.

In many respects, however, the Germans are in a far superior condition to the French, in that they have more social and civil freedom, and enjoy more of the domestic element in private life. Their communes, or parishes, are, like those of the United Kingdom, self-governed, the general government assuming no jurisdiction over them. This privilege is of very ancient date, having existed from the commencement of the organization of society. It is peculiarly a German institution, from which our own was derived. It is this nucleus of freedom that has enabled the Germans to make what progress they have done, in spite of the adverse influences by which they are held down. It is not, however, consistent with the policy of the governments in other respects, that the industrial institutions of these countries should enjoy freedom. To bring them financially under official surveillance the *zollverein* was established, by which the thirty-five states of the Confederation have adopted a system of customs' duties, which compels the people to purchase at the dearest rate all articles of consumption and manufacture.

The outburst of political feeling of 1848 led the continental governments to grant some beneficial reforms; amongst which were, the abolition of tithes, the *corvée,* or compulsory labour, and the law of entail. These useful measures have not yet been fully carried out, but so far as they have been, the land is relieved from its most injurious and oppressive burthens, which acted as prohibitory restraints upon improvement, and were harassing in the extreme to the occupiers of land. What is still wanted in Germany is a closer and more general union of industrial interests and institutions, thereby to combine the several states in a grand organization of manufacturing and agricultural enterprise. A plan of this kind was contemplated in 1848, so far as agriculture was concerned, and could it have been carried into effect, all the agricultural societies of Germany would have been centralised, or, at least, brought into communication with each other, which would have afforded the means of diffusing information on subjects relating to rural economy throughout the length and breadth of the Continent; but the reaction that succeeded the revolutionary movements of that year rendered any measure of the kind impossible, the various governments having imbibed a wholesome horror of *all* combinations of the people, except in *uniform* and military array.

Germany, however, is far from being destitute of agricultural societies. They existed previously to 1848, but in a very inefficient state. Since that year they have sprung into activity in every one of the thirty-five sovereignties of the Union, by which upwards of 120 periodicals on agricultural subjects are issued. By these an immense amount of valuable information is disseminated; although, owing to the jealousy of the governments of a free expression of opinion on matters of a political nature, interfering with, and retarding the progress of, industry, these sources of knowledge can never be fully developed. This *taboo* on all matters relating to the policy of government is the bane of all industrial enterprise on the Continent, poisoning the very sources of prosperity, and preventing the possibility of national progress. One only of all the agricultural societies of Germany can be said to be allowed its full development,—that of Bavaria, which demands a distinct and honourable notice, as being under the patronage of a sovereign, who, contrary to all the established usages of continental administrations, is not afraid to allow his people political rights under an organization that would be looked upon by his brother sovereigns as dangerous to their authority, if not to their existence.*

The Bavarian Agricultural Society had been in existence for some years previous to 1852; but in that year, under the protection of the sovereign, it was entirely reorganized and formed into a corporation, representing the whole agricultural interest of Bavaria. It is divided into provincial societies and land commissariats, the latter of which are synonymous with the French sub-prefectures. At the head of each of these there is a committee of seven members elected popularly by the rest of the members. Each committee selects from amongst themselves a president; and at the head of the whole

* The following account is derived from the *Journal d'Agriculture Pratique,* and was drawn up by Messrs. Villeroy and Müller.

there is, at Munich, a central committee, the members of which are also elected directly by the society.

Each committee has the right of holding general meetings, at which not only all the members of the society are there of *right*, but all cultivators and friends of agriculture are invited to be present. For the decisions adopted in a general assembly, besides the members of the committee, six members chosen by election from amongst the cultivators forming part of the society, vote concurrently with the committee.

Each year, at the agricultural *fête* of the province, the local agricultural societies meet in general assembly, to which each society of the Land Commissariat sends one of its members. These delegates join in the discussion of the questions brought before them, and take the decisions. At the beginning of October the general committee of Munich convokes an assembly, to which each province ought to send two members. To this assembly the government communicates the measures relating to agriculture before submitting them to the Chamber of Deputies, as well as ordinances, however important, before they are definitively adopted.

At the head of the agricultural society is his Majesty the King, as protector. A regular account of the operations of the society is rendered to him, in which he takes the most lively interest. It is to this circumstance that the society is in a great measure indebted for its rapid development, and that the decisions of the society exist, not only upon paper, but are certainly taken into consideration by the administrative authorities. These latter must be previously made acquainted with all the deliberations of the committee, whether at their regular meetings, or when the whole society is convoked; and it is required to have a representative present at these assemblies, in order to furnish the intelligence that may be required, and which it has at its disposal. The representative of the administration has no deliberative voice in the assembly.

The committees are thus corporate bodies and representatives of the administrative authority in all that concerns the interests of agriculture. The Committee of the Land Commissariat co-operates with the Land Commissioner; the Provincial with the President of the Regent of the Province, and the general committee with the minister. The society has not only the right of discussing questions submitted to it, but also of offering propositions, and exposing its grievances, if it has any.

It is evident that a society thus constituted, and enjoying such privileges, may in certain circumstances acquire great national importance. And as it is, above all, composed of proprietors and farmers, it cannot fail to exercise a salutary influence over the government of the state.

Each section of the society, each society of the Land Commissariat, as of the Province, is completely independent in its internal administration, and dispenses freely, according to the local requirements, of the means it has at its disposal. These means are derived from the annual subscriptions of two florins forty-five cruitzers (about 4*s.* 10*d.* English) each member, and the government grants, those of the Provinces, and the Land Commissariat. The first of these grants is determined by the Chambers, and amounts to 30,000 florins, or £2,600 per annum.

The members of the society receive a journal edited by the Central Committee, and which appears monthly. The society consists, at present, of upwards of 18,000 members. This is a large number for a state, the population of which is only 4,000,000. It is annually increasing. Up to the present time, it is chiefly by the distribution of prizes and agricultural shows that the society has sought to exercise its influence. These distributions and festivals draw the public attention to agriculture, stimulate the cultivators, and, above all, tend to improve the breeds of cattle and sheep; but the shows are too frequent. Each Land Commissariat will have its festival, and the prizes are necessarily so small that they do not tempt the breeders to make serious efforts; besides which they are awarded without any preconcerted plan, and progress can never be rapid where no determined object is previously held out; but it must not be forgotten that the society is still young, and that until its plan of operations and designs are well understood by the inhabitants of the rural districts its action cannot be fully developed. The Central Committee of Munich expends the funds at its disposal in the encouragement of special branches; and it has already done much, particularly in the improvement of the breeds of cattle and sheep, and in the multiplication of fish.

Such is the history of the Bavarian Agricultural Society, which as a model institution exercises a considerable influence throughout Germany. All the states have now their organized agricultural institutions, recently established, whilst those that existed previously have received new life and energy from the Bavarian example.

There are three systems of husbandry practised in Germany; first, the three-field husbandry; secondly, the four-field; and thirdly, a system peculiar to Holstein and Mecklenburg, by which the farm is divided into a number of large fields of equal size, which, after several years of corn-bearing, are allowed to remain from three to seven years under a fallow, or in grass for summer grazing. Under the three-field system a three-course husbandry is managed thus: one third of the land of a farm is under winter corn, another third under spring or summer corn, and the third is in fallow. This last is sometimes sown with peas or potatoes. The four-field husbandry appears the most rational of the three, the principle being that no field should be sown with corn two consecutive years, or without, at least, one year's fallow intervening. The course of crops is—first year rye, the second clover, the third oats or barley, the fourth potatoes, the fifth winter corn.

The greater part of the wheat grown in Germany is exported, very little wheaten bread being consumed by the growers. Rye, barley, and buckwheat bread, with potatoes, constitute the chief food of the rural population. Even in the large towns and cities it is difficult to procure wheaten bread; and English travellers usually take some with them if they wish to be supplied with it.

The vineyards of Germany, like those of France, are a source of large revenue to the proprietors. The extent of land appropriated to them, as has been already shown, is 692,737 acres, of which that of Austria amounts to nearly one-third. The quantity of wine produced annually in the German union is 3,000,000 eimers,* the value of which, on the spot, is £3,000,000 sterling.

We have already spoken of the breeding of sheep in Austria and Prussia; this branch of rural economy has been much attended to in several of the other states, the chief of which are Saxony, Silesia, and Bohemia. Moravia and Westphalia are famous for their swine; and the best horses are bred in Mecklenburg and North Hanover. The Spanish Merino sheep were introduced into Saxony about the middle of the last century, and were sedulously attended to by the sovereign, who also patronised the manufacture of woollen cloths. Saxony, as is well known, for many years produced the

* The Prussian eimer is eighteen imperial gallons.

best superfine broadcloths in the world, and its wool was eagerly sought for by the English cloth manufacturers. The mountainous parts of the country are particularly adapted to the Merino sheep, and large flocks of them are fed there. Of late years, however, the Australian wool has, to a great extent, taken the place of the continental wools in the English market, being now quite equal to the wools of Saxony in fineness and quality, and of a longer staple. The following table will show the gradual increase of the former, and the decrease of the latter since the year 1815, at intervals of five years, up to 1860 :—

	1815.	1820.	1825.	1830.	1835.
Australian . .	72,171	99,415	320,995	1,967,309	4,210,301
German . . .	3,135,438	5,113,424	28,799,661	26,073,882	23,798,186
	1840.	1845.	1850.	1855.	1860.
Australian . .	9,721,248	24,177,317	39,918,221	49,142,106	
German . . .	21,812,664	18,484,736	9,166,731	6,128,626	

The small quantity of German wool imported into the United Kingdom in the two first periods is fully accounted for by the state in which Germany was left at the conclusion of the war, after having been overrun and ravaged by the immense armies alternately of France and of the allied powers. Whether as friends or as enemies, their presence was equally destructive of agriculture, and wasteful of the resources of the countries through which they passed. At present the woollen manufactories of Germany consume the greatest portion of the wool grown there, now that the demand in the United Kingdom is supplied from her own colonies.

Tobacco is extensively cultivated in most of the German states, but particularly in the Rhenish provinces, in the Grand Duchy of Baden, in Hesse, Bavaria, &c. In Baden, since the disease has attacked the vine, and rendered its culture precarious, the vineyards have been rooted up, and the land cultivated to a considerable extent with tobacco, for which the soil is well adapted. Some of the farmers plant half their land with this exhausting crop, which gives no return of manure, and must therefore necessarily impoverish the soil, unless its fertility is kept up by artificial manures.

The same cause which has suggested the extension of the tobacco culture in Baden, has given rise to the establishment of breweries, particularly in Bavaria and Rhenish Prussia. A few years ago beer was scarcely seen in old Bavaria, and now the breweries of that country consume upwards of 1,000,000 quarters of barley per annum, which allows an average of about $2\frac{1}{2}$ bushels to every head of the population. In the Rhenish provinces a company has been formed for brewing, on a large scale, English porter and ale. It is difficult, however, to induce a people to alter their habits of living; and it is probable that, should the vine recover its former vigour and health, the population of those countries in which it was cultivated will revert to their ancient favourite beverage.

In Prussia proper, Hanover, and other parts of northern Germany, immense quantities of beer are drank by all classes. It is almost incredible how much of that heavy beverage some of the most respectable of the middle class will take in the course of one day.

SECTION VIII.

THE AGRICULTURE OF SWITZERLAND.

There are some peculiarities in the Swiss management of their little properties that render them objects of considerable interest. If there is any country in which the subdivision of the land into small farms is found to be beneficial to the occupiers, it is where they add to it the business of a manufacturer. It is this that distinguishes the cottier farmers of the north of Ireland from those of the west and south, nearly all of them, or their families, having other means of gaining a livelihood than that of husbandry. Some of them are linen weavers, others lace makers; whilst vast numbers of the females are employed in the "sewed muslin trade," which is carried on to an enormous extent from Belfast to Dublin, in both of which, and at some intermediate towns, extensive establishments exist for its prosecution. The consequence is, that the condition of the peasantry of Ulster and part of Leinster is far superior in point of comfort and cleanliness, and the little farms better cultivated, than in the purely agricultural provinces of Munster and Connaught.

Switzerland presents another example of similar advantages, derived from this union of the two occupations of husbandry and manufacture, by which all the individuals of a family are at all times and seasons profitably employed. During the winter months, when out-door work is suspended, except that of attending to the cattle, the peasantry occupy themselves in different employments peculiar to the different cantons. Thus, in those of Saint Gaul, Appenzel, and Zurich, linen and cotton fabrics are woven, whilst in the environs of Basle silk goods are manufactured, and in the Jura, of which Geneva is the capital, the construction of clocks and watches is extensively carried on. This latter employment, as well as the two former, is chiefly conducted by females, whose delicacy of touch is found peculiarly adapted to the handling of the small mechanism of the watch. These female watchmakers are thus enabled, with economy, to save money enough to render themselves comfortable in old age. The produce of their labour is chiefly exported to the United Kingdom and France; and it is astonishing the numbers that are annually completed by them. One grand object with them all is, to be able when they marry to possess a few cows, and land enough to support them in winter. This is the *ultima thule* of a female Swiss peasant's ambition.

The land in Switzerland is subject to a law of inheritance similar to that of France, but it does not appear to be so rigorously carried out there as in the latter country. The chief object of the Swiss proprietors, at least in some of the cantons, is to lay by money enough to be able to give equal portions to all their children without dividing the estates, which are usually left intact to the *youngest* sons. If unable to effect this, the land is still left to the youngest sons, charged with the encumbrance of an interest equal to that on the sum it is considered the other children ought to have had as an equivalent for a portion of the land. When, however, the subdivision of an estate in land takes place on the death of the proprietor, care is taken to avoid the extreme *morcellement* that takes place in France and Germany, by which every little slip is liable to be divided into as many portions as there are children. But whichever way the settlement of an estate is accomplished, the system is opposed to the improvement of the soil; for it is evident that if the father lays up his savings in order to portion off his children, he cannot expend any in improvements beyond what is necessary for his own comfort. Owing, however, to the fortunate position in other respects of the Swiss peasantry, and the remarkably intelligent and judicious manner in which they manage their affairs, the injury is less felt there than in either France or Germany, where husbandry is the sole employment of the rural population, and those excellent combinations do not exist which distinguish the Swiss, and which we shall now briefly describe.

In Switzerland each parish has its *alp* or common land, as was formerly the case in England. Every inhabitant is entitled to send one cow to pasture on the common from June to October, and this is justly considered one of their most valuable privileges, the cow being an important part of a Swiss peasant's establishment, and one that engages his attention winter and summer. The system pursued in most of the cantons is admirably adapted to secure to them the full value of the produce of their cows. Extensive cheese manufactories or dairies are formed in every parish or village, superintended by a person who fully understands the business. The cows, when at grass, are under the care of a cowherd, who drives them night and morning to the *cheese-house*, where they are milked by the *cheese-man* and his assistants. We have already had occasion to refer to this Swiss plan (see page 42) which has also been adopted by the inhabitants of the French Alps; and it is evident that by it the value of the produce is greatly enhanced by the superior quality of the cheese thus manufactured; for it would be impossible for the owner of one or two cows, or even half-a-dozen, to be able to make cheese of so marketable a quality; whereas upon the Swiss principle cheeses are constantly made, superior to the best Cheshire, which always bring the highest price in the markets of England and France. Most of the *cheese-men* are from Gruyère, in the canton of Friburg, from which circumstance all the cheeses are called "*Gruyère cheese.*" About forty cows is the number attached to each cheese-house; and the establishment consists of the cheese-man, the press-man, and the herd. The milk is all mixed together, so that only one quality of cheese can be made; this is uniform throughout the season, being under the undivided attention and control of a person fully competent to his work. Sometimes the cheese-man hires the cows, or a part of them, and pays the owners in either cheese or money, as may be agreed on. The cheese making ends in October, after which, during the winter months, the cows are fed at home with the hay cut off the meadows during the summer, which, if the pastures have not been fed off, is amply sufficient. Some of the valleys that lie to the sun afford grass almost the year round. The cultivation of cereal crops is quite secondary to the dairy.

This principle of association—that by which the Swiss acquired their liberty, and have maintained it for upwards of 200 years—is carried into almost every department of their social economy. In the neighbourhood of the large towns, especially Geneva, where the consumption of milk is large, instead of making it into cheese, the farmers have formed themselves into a company, to supply the inhabitants by means of a central dairy, by which a certain sale is secured for the milk at a more remunerating price than if it was made into cheese. A similar association has been established for the sale of forage as well as milk. The price at which the latter is charged to the dairy is 22 centimes ($2\frac{1}{8}d.$) the *pot* of about $1\frac{1}{4}$ pint.

One of the principal objections to small farming is the impossibility of employing the best, and most expensive, machines to the same advantage as on large farms, where it answers the purpose of the farmer to purchase them at great cost. The Swiss peasant farmers have overcome this difficulty by the application of the same principle of association, especially in the commune of Meyrin, in the canton of Geneva. Here a society has been instituted for the purchase and use of agricultural machines and implements, towards which the members subscribe or hold shares of 25 francs each. On first starting they purchased a portable threshing machine, a chevalier drill, &c., and the profits accruing from the letting of these machines were invested in the purchase of others of the most modern construction, which plan they proposed to pursue, until they had supplied themselves with every essential machine; after this the profits were to be divided amongst the shareholders. Thus the small farmers of Switzerland have endeavoured by the principle of combination to overcome the difficulties to which the system of which they form a part is liable, and are thereby enabled to enjoy the benefit of those expensive machines which the large farmers of England possess for their own exclusive use. The following account of the rules of the association is interesting :—

Art. 1. The machines, &c., will be granted, in the first place, to the shareholders, then to the inhabitants of the commune, and lastly to strangers; they will be sent in the order of registry.

Art. 2. The shareholder or hirer can have a machine for only one day, if it be required by another shareholder. The threshing machine only can be hired for several days.

Art. 3. Persons who shall use the machines shall be responsible for accidents caused by their own carelessness; payment to be made to the secretary. They are taken from, and returned to, the depot at the hirer's expense.

Art. 4. A register is kept for each machine, which is the foundation of the accounts.

Art. 5. In case of the disarrangement of a machine the term of hire will commence immediately after the repairs are executed.

Art. 6. The hirer of the threshing machine must fetch it at his own expense, and take it back on the evening of the last day of his term. The same rule applies to the large fan, or winnowing machine that accompanies the threshing machine.

Art. 7. The threshing machine must be accompanied by the superintendent, who must be boarded and paid by the hirer, according to a rate fixed by the company.

For example, the rate of charge is, for the drill machine, 3 francs per day; for the threshing machine and its superintendent, 7 francs per day of ten hours, in summer; 4 francs for half a day of five hours; 5 francs for a day in winter of eight hours; or 3 fr. 50 c. for half a day of four hours, &c.

In some of the communes there are public bakehouses and forges, under the superintendence of a marshal; at these the work is performed by workmen belonging to the commune at a stated price, as in the case of the machines. There are also mutual insurance societies or companies against fire, against mortality in cattle, for improvements in the culture of the vine, and for supplying the shareholders with butchers' meat.

The latter charge the subscribers for the meat at the cost price, deducting only the expenses of slaughtering, rent of premises, &c. This institution is called the "Agricultural Butchery," and is under admirable regulations, widely different from those of the Parisian butchery, being conducted by, and under the control of the people themselves, without any interference of the government. Persons not shareholders are allowed to subscribe, and receive the benefits of the association; the only difference that is made being, that they are obliged to deposit 15 francs on entering their names. No sheep are pastured by the Geneva farmers; the mutton, therefore, with which the association is supplied is purchased from Savoy and the south of Germany. For this purpose a reserve fund is created out of the capital, or by an additional subscription from the members. By this system the consumers and the producers are brought into direct communication without the intermediation of the cattle jobbers, salesmen, or butchers, and their arbitrary and large profits which add so greatly to the price of all animal food.

Such are the main principles on which the agriculture of Switzerland is conducted, and nothing can be more admirable than the cordiality and unanimity with which these associations are sustained. It is evident, however, that the social combinations thus formed and worked, owe their origin and success mainly to the character of the Swiss people, superinduced by the peculiar position in which they are placed, and the absolute necessity they have been under to unite and stand, as it were, shoulder to shoulder in support of their freedom and nationality. This brotherhood, in the strictest sense of the word, has created in them the element and principle of association, which it was easy to apply and carry out, when the necessity or expediency of circumstances called for it, in social and economic undertakings. We know, in fact, no other people similarly circumstanced; those nearest approaching to them being the inhabitants of the mountainous parts of France; but these have never been placed in anything like a similar position with the Swiss, and, therefore, have never had occasion to form those close political combinations in which every individual has an interest in the life and welfare of his neighbour. On the contrary, society in France is separated into different factions, which destroy the element of combination in its purer political form, and thus render more difficult the application of its principle in social life. Agricultural societies will do much to remedy this want, but France can never, in her political or social institutions, exhibit that closeness of brotherhood which binds the inhabitants of Switzerland, both to the soil and to each other, by one common feeling of self-preservation.

SECTION IX.

BELGIAN AGRICULTURE.

The history of the "Low Countries" presents as remarkable an instance of the triumph of human industry over the defects of nature as is to be found in any country. It is out of our power to say when agriculture first took its rise in that part of the Continent, but certain it is, that long before the art was advanced beyond the first rudiments in England, the Flemings were practising many of the processes which are now considered indispensable to good husbandry, and which have not long been introduced generally among us. It is known that as early as the thirteenth century the Flemings were far advanced in agriculture, and it is equally true that they have ever since that period served as a model both in England and amongst the continental nations. In those early times books of agriculture were scarcely known, and, therefore, no records were kept of its transactions; this confined the knowledge of its practice amongst the Flemings to those who visited the country; and travelling was less easy and less fashionable then than it has been since. We learn, however, from the history of the times, that Queen Elizabeth, when she wanted vegetables for her dinner, was obliged to send over to the "Low Countries" for them.

Towards the latter end of the sixteenth, and at the beginning of the seventeenth, centuries several English writers on agriculture went over to Flanders for the purpose of studying their system of husbandry. This was the case with Sir R. Weston, Hartlib, and others, who, on their return, published an account of what they saw, and their works remain, at this day, proofs of the advanced state of agriculture in that country. Most of our forage plants, as clover, ray grass, lucerne, turnips, cabbages, &c. &c., have been derived from the Flemings, who probably cultivated them hundreds of years before they were introduced into England, which was not until the sixteenth century, and then the two last were only used as garden plants for the table.

Belgium, according to the arrangement made at the time of its separation from Holland in 1830, is divided into nine provinces, namely—Antwerp in the north, West and East Flanders, and Hainault in the west, Namur in the south, Luxemburg in the south-east, Liège and Limbourg in the east, and Brabant in the centre. It has an area of 6,432,477 acres of cultivated land, of which 3,494,507 acres are in the hands of proprietors, and 2,937,970 acres are let to tenants. In West Flanders eighty-five per cent. of the lands are so let, whilst in Luxembourg three-fourths are occupied by small proprietors. In Antwerp, Brabant, and East Flanders three-fourths are held by tenants. The land is divided into 600,000 properties, in the following proportions:—

Farms not exceeding	$1\frac{1}{4}$ acres	43	per cent.
" "	$2\frac{1}{2}$ "	12	" "
" "	$11\frac{1}{2}$ "	29	" "
" "	23 "	7·47	"
" exceeding the above		8·53	"
		100·00	

The following proportions (per 1,000 acres) are generally observed in cropping in Flanders, &c. :—

	Acres.
Cereal and farinaceous crops	337·34
Alimentary roots	50·66
Manufacturing plants	25·22
Leguminous plants	26·38
Fodder plants	59·83
Prairie land	139·19
Fallows	31·08
Gardens	19·17
Wood	186·58
Waste, or cultivated periodically	124·55
	1000·00

The country for the most part is very flat, except in the east and south-east, where the frontier joins that of France, the mountains of which are continued in Belgium, gradually sloping down until they are lost in the plains. The provinces of Liège, Luxemburg, and Namur present the greatest irregularity of surface, being intersected in all directions with deep valleys and ravines, ridges of hills and mountain streams. A part of the Ardennes reach into Belgium, and dense forests are found in these districts. The inhabitants are poor, and subsist chiefly by pasturage of flocks of sheep and lean cattle, which pick up a scanty subsistence on the natural grasses that clothe the high grounds. In leaving these the traveller comes upon a well-cultivated country, and in the west and north-west encounters the far-famed husbandry of the "Low Countries," from which, as a pattern, the young agriculturists of the Continent, and formerly of England, have been directed to look for model farming.

But however early the Flemings may have been celebrated for the attention paid by them to agriculture, and the success with which it has been followed, they have by no means progressed with the times so far as to originate or adopt any of the newest methods by which the soil of England has been rendered so productive. As a whole, in fact, the Flemish husbandry is rather gardening than farming, the necessary consequence of that subdivision of the land into small properties indicated in the table given above; and in accordance with that plan, the object of the cultivators of these small farms is to grow a little of everything that can be useful in the maintenance of a family. Such patches afford little room or opportunity for improvements or experiments; and the plans by which former occupiers cultivated their lands are adopted implicitly by their descendants, without any desire to become acquainted with a better. Science is quite out of the question with the great majority of these small holders, who have no scope for the use of modern machinery, even if they had the money to spare to purchase it.

The peculiar system of Flemish husbandry naturally involves a large amount of manual labour, and this is sedulously bestowed; the small farming of this country forms, indeed, a striking contrast with that of the same class in Ireland. In the former, weeds are scarcely to be seen, whilst in the latter they are in some cases more than tolerated.* The

* The writer was once travelling from Dublin to Belfast; and as he passed, one after another, fields of both grass (clover and ray grass) and corn so full of weeds as to make it difficult to tell what the intended crop was, he observed to a farmer, who sat by his side on the coach, that an Englishman would call it bad farming, "Well, sure," he replied, "the weeds might have been pulled out of the corn; but as for the hay, *would not the crop be all the heavier for them?*" The philosophy of this was better than the rhetoric.

Flemings spare no pains either in keeping their land clean, or in procuring and preparing manure for the crops. There is, however, no lack of machines on the few large farms, nor any want of enterprise with some of the occupiers. Straw cutters, root cutters, oil cake crushers, threshing and reaping machines, &c. &c., have been introduced and are becoming common; draining, too, is beginning to be considered a *sine quâ non* in good husbandry, although it has made but little progress at present. Drain tiles are furnished by the state, which has fifteen manufactories of tiles in different parts of the country. Prizes are also offered to those proprietors and farmers who shall execute the largest extent of drainage on the best plan.

The following table shows the distribution of the land amongst the different provinces:—

Provinces.	Cultivated.	Uncultivated.	Covered with buildings.	Canals and roads.	Total acres.
Limburg . .	766,582	344,169	3,654	37,729	1,152,134
Liège . . .	586,523	100,848	2,258	23,818	713,447
Namur . . .	687,292	145,555	2,286	23,209	858,342
Luxemburg .	1,144,076	414,158	3,609	43,378	1,605,221
Hainault . .	879,512	8,529	7,313	24,179	919,533
Brabant (South)	782,304	3,347	4,365	20,784	810,800
East Flanders .	654,190	3,234	10,917	28,739	697,080
West Flanders .	733,008	21,453	4,974	22,132	781,567
Antwerp . .	487,092	179,357	4,244	30,014	700,707
Totals	6,720,579	1,220,650	43,620	253,982	8,238,831

Industrial or manufacturing plants form a large portion of the produce of Flanders. Amongst these, colza or rape seed and the Silesian beetroot are the most extensively cultivated; the former for the extraction of oil, and the latter for the manufacture of sugar and the distillation of spirits. Most of the villages have an oil mill, attached in some cases to a wind corn mill, or, in others, erected separately, but still generally worked by the wind. The proprietors of the mills either purchase the seed and manufacture it on their own account, or they crush it for the grower at a stated price, returning both the cake and the oil, or selling the latter on commission. The expense of the manufacture of the oil by steam power, is about 30*s.* per ton. The sugar factories are not at present numerous in Flanders, but they are increasing as well as the distilleries.

Chicory is another important article of production, and its cultivation is continually on the increase. It supplies the place of coffee entirely with the rural population; and furnishes in its preparation employment for a great number of hands.

One of the most remarkable features in Flemish husbandry is the employment of liquid manure, which, while in England agriculturists are still wrangling about its value, has been used time out of mind by the Flemish farmers, who employ every method to procure and increase its production. The most approved material employed for this purpose is *vidange*, or a mixture of which the principal ingredient is night-soil; this is most carefully preserved, and we may say manufactured, in tanks; into these, also, all the excretæ of horses and other animals are conveyed by open drains or gutters. Rape cake also is mixed with this *engrais liquide*. The night-soil is collected in the towns, and carried in carts, sometimes seven or eight miles, by persons who make it their business, and are called *commissaires de vidanges*, or night-soil commissaries. Tanks are also constructed by the road-sides by these commissaries, and their contents form an important article of commerce. When opened, either to be filled or emptied, these tanks perfume the air for a considerable space, according to the direction and force of the wind. The fermentation is allowed to spend itself and subside before the *vidange* is considered fit for use.

The application of the liquid manure to the land is differently performed, according to the means of the farmer, or his advancement in the art of husbandry. The most common method is to convey it to the field in a barrel containing 100 or 120 gallons: but sometimes in a smaller cask carried by two men, or on a wheelbarrow. When arrived at the field it is emptied into a smaller open tub with handles to lift it to whatever part of the field it is required. Sometimes it is distributed broadcast over the land with a ladle, and at others it is applied to the roots in the rows of plants, especially tobacco. The peasants are very expert in throwing it into the air so as to make it fall like a shower of rain. One of the chief recommendations in the view of the Belgian farmers of this mode of applying manure is, immediate assimilation and consequent benefit to the crop, whilst it is wholly free from the seeds of plants inimical to good husbandry. On the large farms, carts, something similar to an English water-cart employed to water the roads with, are used, by which the liquid is more readily and evenly distributed over the land. The principal crops to which it is applied are flax, colza, hemp, and tobacco, and sometimes to cereals, but not commonly. The quantity applied varies from fifty to 200 hectolitres per hectare.*

This kind of compost is, *par excellence*, called *engrais Flamand;* on the other hand, the common farm-yard manure is very little attended to, being thrown from the stable or cattle sheds into the open yards, where it lies exposed to all weathers, by which its fertilising properties are much weakened, the liquid from it being allowed to run to waste. It is only the more intelligent of the farmers who see the folly of this, and by these the stable and cattle-shed dung is carefully kept in covered dung-pits, where it is mixed with earth and other materials in alternate layers. It is left to ferment, after which it is turned over and well mixed. A second fermentation for ten or twelve days finishes the process, and the manure is in a fit state to be applied. The quantity used is about eight cart loads, or sixteen cubic metres per acre.† This is the system pursued by Baron Peers, one of the most enlightened and public-spirited agriculturists in Belgium. In order to retain the fertilising elements of the compost, he employs sulphate of iron at the rate of one kilogramme of sulphate dissolved in twenty pints of hot water to twenty head of cattle. The effect is to fix the ammoniacal and other volatile salts, and at the same time prevent the pungent smell arising from the urine and dung of horses or cattle, thus rendering the atmosphere of the stables perfectly pure. The increased value of the manure he has proved by experiments carefully conducted. Two lots of ground were manured, one with 100 kilogrammes of dung with, and the other with the same quantity without, the sulphate. The former produced 440 kilogrammes, and the latter only 410 kilogrammes of ruta-bagas, making a difference of 3,000 kilogrammes per hectare, or upwards of 24 cwt. per acre.

The solid manure heap is increased by the addition of every vegetable substance that can be collected by the children of the small farmers. For this purpose they scour

* The hectolitre is 22·009668 imperial gallons; the hectare two acres, one rood, thirty-five perches.—*Spiers.*

† See "Notes taken during a Tour in Belgium," by R. S. Burn, in the *Edinburgh Journal of Agriculture*, July, 1859, from which and the following numbers our account is chiefly derived.

the highways and canals, for parings of grass found on the sides of ditches and roads, and anything that is capable of fermentation or rapid decay; water plants are particularly coveted, and are applied to the roots of potatoes, which they materially assist in their growth. Green crops, such as buckwheat, lupins, spurry, &c., are raised for the purpose of being ploughed in as manure in the green state. On the light, sandy soils this has been found to enrich them in a high degree. Cake-meal is used in every variety of methods as top-dressing, mixed with other materials in the *vidange* tanks, or put in with the seed of beet and other crops. It is applied on meadow as well as arable land; and clover is top-dressed with it in a liquid form. In mixing it with other ingredients in the tanks, it is allowed to ferment for a fortnight before being used, by which means it becomes thoroughly incorporated with the whole mass, and comes out a rich compound of chemical matters, in a perfectly assimilable state.

Spade husbandry is universally practised in Flanders, but not to the exclusion of the plough. Some of the proprietors stipulate with their tenants that a sixth or seventh part of the land shall be dug up every year. A singular method is practised, of a man following the plough and deepening the furrows with the spade, throwing the mould over the ploughed part, where during the winter it receives the benefit of the frost. Sometimes double ploughing is practised; that is, one plough follows another, thus obtaining a depth of from fifteen to eighteen inches. Deep tillage is, in fact, one of the most striking peculiarities of the Flemish husbandry, and, in conjunction with repeated stirring of the soil, and a constant warfare with weeds, goes far to account for its success.

The introduction of the subsoil-plough, about the year 1852, by an agricultural committee, has been attended with great success. Ten of those implements were purchased and sold by auction, at a loss to the committee of 100 francs. The next year twenty more were purchased, and, in the same way, sold at the cost price; and now most of the subscribers to the association have them, and find the greatest benefit from bringing up the new soil to the surface.

Attention is paid by the Belgian government to the breeds of horses and cattle, and through its influence and efforts, a desire prevails throughout the country to improve the native races. In West Flanders the Durham race has been introduced, and stations are appointed throughout the province, for bulls and cows, in order to facilitate the extension of the cross with the native cattle. In 1857 there were at these stations seventy-six bulls, and ninety-two milch cows, of the estimated value of 84,000 francs (£3,500 sterling). It is calculated that the value of the cattle has been increased to the extent of one-third, and that, at a much lower estimate, the increased value of the entire stock in the province, in five years, has amounted to 6,000,000 francs (£250,000), at an expense of only 300,000 francs. Great merit is due to Baron Peers (to whom reference has just been made) for his untiring efforts to introduce the Durham cattle, of which he has as fine a collection as any English breeder, from whose herds, indeed, his own were carefully selected, without regard to price. Every year he has a sale of these cattle, and if they do not bring such prices as are realized in England, they amply remunerate the enterprising baron for the outlay he has ventured to incur.

Sheep have been less attended to in Flanders, hitherto, than cattle, the smallness of the farms being one obstacle to their being kept. Two stations have been established, at which one ram and one ewe, of the Hampshire-Down breed, were kept in 1859; but it will require some time to convince the small farmers of the superior advantage of sheep over bullocks and horses, of which latter great numbers are bred in Flanders, constituting one of its most important branches of agricultural industry. M. de Lavergne, however, questions whether the outlay of rearing is not greater than the sale of them will cover, and whether sheep would not prove more advantageous in every respect, and be attended with much less trouble and expense. The favourite maxim of the Flemish farmer is, "No cattle, no manure; no manure, no corn." It is, however, a well-established fact, that the dung of ruminating animals is more valuable than that of others on account of the more complete mastication of their food, which renders their excretæ easier and quicker of assimilation by the plants. In some experiments, made by M. Boussingault, on the comparative value of different manures in the production of wheat, the results as regards sheep's and horses' dung were as follows:—

	Gluten.	Starch.	Bran, &c.
Sheep's dung	32·9 . . .	42·4 . . .	24·7
Horse dung	13·7 . . .	61·6 . . .	24·7

It is the amount of gluten that determines the value of wheat as an article of human food; and this experiment shows that the sheep's dung produced more than double of that substance, of what the horse dung yielded.

There appears to be no uniform course of cropping in Flanders, each farmer following that which appears the most profitable to him. The distinguishing characteristic of their system, and that which stamps its superiority over the French farmer's management, is the entire absence of fallows, whilst every effort is made to increase the fertility of the soil, by the application of abundance of the best manure they can obtain. The following are some of the rotations, according to the nature of the soil:—

For a light, sandy soil—1st year, potatoes; 2nd, rye, with carrots, liquid manure being largely used with the latter crop; 3rd, flax; 4th, rye; 5th, turnips; 6th, oats.

For a rich, light soil—1st year, tobacco; 2nd, colza; 3rd, wheat with clover, or rye, according to the richness of the soil; 4th, clover; 5th, rye; 6th, oats; 7th, flax; 8th, turnips.

For a good clay or strong loam—1st year, flax; 2nd, rye or wheat; 3rd, rye or turnips; 4th, potatoes; 5th, wheat or rye, with clover; 6th, clover; 7th, clover; 8th, oats.

These, however, are varied according to the quality of the soil; but, in all cases, care is taken to prevent its exhaustion, by compensating dressings, so that the land, although constantly under crop, is never deteriorated. Such has been the practice of the Flemish farmers time out of mind; and the result proves that, whilst ignorant of the principles on which their practice is founded, experience has taught them that the complete pulverization of the soil and abundance of manure are all that is necessary to produce a corresponding beneficial result.

In the neighbourhood of Courtrai flax is cultivated to a large extent. Considered by the British farmer as a very exhausting plant, it is quite the reverse with the Flemish farmer. Far from robbing the soil of its fertilising elements, he finds it greatly increases them, besides yielding large remuneration to the grower. It is, however, only by the most assiduous attention, and the application of an abundance of manure, that such a result is obtained. The long period during which the Flemands have continued the cultivation, is a sufficient proof that they are correct in their ideas respecting it. All the characteristics of good farming are observable in the flax-culture; high manuring, deep tillage, a constant warfare with weeds, and particular attention to the crop that should precede it, which is either clover, tobacco, hemp, or wheat. Almost any soil appears suitable for growing flax, but the finest and best is produced from a sandy loam; in all cases the same attention is paid to the above husbandry. The manures employed are those we have already referred to, but oil-cake (rape) enters largely into the various compounds used for this crop. The land is tilled either with the plough or spade; when the former is used, it turns a furrow about eight inches wide and eleven deep. With the spade the soil is gradually trenched deeper and deeper, till it is pulverised to the depth of eighteen or twenty inches. In the autumn it receives two, and sometimes three workings; and after the winter's frost has mellowed the surface, it is merely harrowed down, and the seed is then sown. The average produce is 33 to 34 cwt. per acre. That of cereals is—wheat, from 20 to 28 bushels; spelt, 30 to 36 ditto; barley, 60 to 80; oats, 80 to 96. Peas will yield 24 bushels; beans, 34 ditto; and potatoes, 250 bushels per acre.

The richest pastures in Belgium are in the north of West Flanders, on the Durme and Lower Scheldt. These can be overflowed by the tide when required, and are mowed twice a year. The cows are always kept in stalls, summer and winter. In the former season they are fed with clover, and with barley and oats cut in the green state; in winter, with beetroot and turnips, chopped up together and boiled, and then given to them milk-warm. This mixture is called *brassin*. The cows are generally fattened at four years old. The meadows are mostly held by the large farmers, who rent them as auxiliaries to their farms, which are sometimes at a distance. In order to improve them, they occasionally break them up, and sow them with oats, two years in succession, obtaining thus heavy crops. They are then laid down again with the best grass seeds they can procure.

The Polders are an extensive tract of country, recovered by degrees from the sea, and protected by embankments, which extend also along the banks of the rivers Meuse and Scheldt, to prevent their overflowing at the high tides or after the winter rains and snows. The Polders contain nearly 200 square miles, or 128,000 acres, and are continually increasing by the silting up of the creeks and harbours. The soil is composed of sand, clay, and the *débris* of every kind from the ocean, being found, upon analysis, to contain the following proportions:—

Calcareous sand, mostly broken shells	13
Siliceous sand	5
Fine clay and vegetable matter	81
Soluble matter, and loss	1
	100

The Polder farms are from 100 to 250 acres in extent, although many are smaller. The cultivation is very different from that of West Flanders, which may perhaps be ascribed to the goodness of the soil. What West Flanders is, it has been made by the industry and application of the inhabitants, for generally speaking the soil itself is very poor, mostly a barren sand, originally covered with heath, furze, or broom. The soil of the Polders, on the contrary, as may be judged from the above analysis, is naturally rich and fertile, and can be kept in that state by the admission of the tides from the rivers by the numerous sluices erected for that purpose in the embankments. There is, therefore, the less occasion for that unremitting attention that the soil of West Flanders requires. Cereal crops may be grown many years in succession without manure; but the course of cropping is also distinguished from that of West Flanders by the fallow, the following being the usual routine:—1st, fallow; 2nd, barley; 3rd, beans; 4th, wheat; 5th, beans; 6th, wheat; 7th, fallow with clover; 8th, wheat; 9th, potatoes and carrots; 10th, oats. Very few cattle are kept, so that but little manure is raised or applied, and the fallow, with irrigation, is chiefly relied on for the renovation of the soil. The meadows furnish abundance of grass for the cows during the summer, and great quantities of butter and cheese are made. In winter there are no root crops provided for them, and they receive but little care or attention; so that when turned out to grass in the spring, they are the mere skeletons of the animals that were taken into the stalls at the commencement of the winter.

The almost entire absence of root and green corps is the distinguishing feature and defect of the farming in the Polder district, which is the more calculated to excite surprise from the example they have in West Flanders. The indigenous breed of cattle are well adapted to the country, being apt to fatten, and the cows are excellent milkers. It is therefore the more inexplicable that there should be no winter food provided for them, or that greater attention should not be paid to their improvement. Exertions are making to introduce a better system by the cultivation of root crops, which would completely revolutionise the present routine, and increase the productive powers of the soil, already so rich in all the elements of fertility.

The Polder farmers have adopted the praiseworthy practice of remunerating their labourers by giving them small portions of land for raising crops of potatoes, flax, &c. In some cases they even let off a portion of their farms to a labourer, the landlord providing implements, working cattle, and buildings, and the tenant doing all the work. In these cases the produce is generally divided between them. The houses in the Polder district are mostly good and remarkably clean, but less numerous than in West Flanders, because the farms are larger. The farm buildings are poor, and not well kept. The roads are very indifferent, and in winter nearly impassable. In that season, however, the river and the canals form the principal high roads for travelling from town to town, at least, in lieu of pedestrianism. There is, however, but little intercourse kept up between distant places in winter, and the Polder farmer is at best an isolated being. The climate is very unhealthy for strangers, on account of the "Polder fever," which commonly attacks those who have not been acclimated by a long residence in the country.

The district of the Pay de Waes lies between Ghent and Antwerp. Originally it was nothing but a sterile sand covered with heather, but by persevering industry it has been rendered a marvel of fertility. The spade culture is generally practised, and most of the farms are very small, but the care with which they are cultivated is extraordinary. A cow is kept for every three acres, being fed entirely on artificial grasses and roots. On a farm of six acres, "one acre is trenched twenty inches deep every year, well manured with the dung and urine of the cows, and planted with potatoes, part of an early kind and part of a later, as the land is ready, from the beginning of April to the end of May. If the soil is fit for wheat, this is usually the next crop; if it is too sandy, rye is sown instead. The taking up of the potatoes gives a sufficient tillage for the wheat or rye, which is sown as soon as the potatoes are off, and the seed is covered by digging narrow trenches at six or seven feet distance from each other, and throwing the earth over the bed. The land is rolled or trodden with the feet, which last is the best on light soils.

Half an acre of land is usually in carrots, which have either been sown with the flax, or, which is much better, by themselves. The turnips are always sown on a stubble. The land which has borne rye is generally preferred for this purpose, because it is the first crop reaped. Sometimes oats are sown immediately after harvest, to be cut green for the cows before winter; or winter barley for the early spring. The rotation of crops followed by the small spade-farmers varies exceedingly, according to the soil, situation, or other circumstances. Hemp, flax, or colza seldom occur in less than nine or ten years, as they require much manure, and do not succeed if sown too often. Wheat usually occupies a fourth or a third of the land, rye a sixth, potatoes a sixth, clover an eighth. Carrots and turnips are usually secondary crops, although occasionally sown also as principal ones. The successions generally are as follows:—

Wheat after clover, potatoes, or beans.
Rye and turnips after potatoes.
Oats after turnips, or carrots.
Potatoes after hemp, potatoes, or carrots.
Hemp after turnips.
Colza after flax.
Beans after wheat or clover.
Turnips after rye, barley, or oats, the same year.
Carrots in the rye, or the flax, after clover.
Clover in flax, oats, or wheat.
Winter barley to cut green in spring, after potatoes.

When any other produce is raised, such as peas, tares, poppies, cameline, beetroot, or parsnips, they only take the place of those crops that are most nearly allied to them, whether pulse, oleaginous seeds, or roots, without altering the succession. A family of five—the man, his wife, and three children—can cultivate without extraneous assistance six acres of land in this district, living off one acre and a half devoted to potatoes and grain, giving an acre for roots and clover for the feed of the cow, and selling the produce of the remaining three acres and a half, which bear the best-paying crops, as flax, colza, &c., to pay the rent and clothing expenses."*

The above passage gives a flattering view of the condition of the small farmers of Belgium, and certainly a very different one to that given by Lavergne of those of France. The condition of the labouring peasantry is equally gratifying. With wages of 67 centimes (about $6\frac{1}{2}d.$) per day and his food he manages to keep his family and himself in sufficient food and good clothing. "Once, and only once," says the narrator, "did we see, during our wanderings in Flanders, both last year and this, a child with ragged clothes; and rarely in the rural districts are you solicited for alms. None of the signs of squalid poverty which too often disgrace our villages and hamlets are met with." The secret, however, of this desirable state of things is explained in the next passage but one: "*Drunkenness, that great curse of our population, is very rare, and frugality and economy are practised by all.*" Would to heaven that it was possible to indoctrinate the rural population of England with this Belgian sobriety and prudence, the want of which is the cause of nine-tenths of the misery and crime with which this country is cursed!

The result, too, in respect to the domestic comfort of the rural population is striking, considering the exceeding slender means of the Belgian peasantry. "The houses are

* See the *Edinburgh Journal of Agriculture* for July, 1860, article "Notes taken during a Tour through Belgium, Holland, and on the Rhine," by R. S. Burn.

small; the general living room is on the ground floor, with a small room or closet or two off it for sleeping. A bedroom is generally above it in the attic, and lighted with a dormer or roof-window. The furniture is of little amount, very plain, generally of birch; but cleanliness and a thorough-going air of material comfort pervade throughout. The stove is a prominent feature; and another not less prominent one is the brass utensils of various kinds, which every Flemish housewife must have, and which are always kept in a condition of the brightest purity. The neat, clean blouse is universally worn by the men; wooden shoes by both sexes. The Sunday and *fête* day clothing of the peasantry is wonderfully excellent for people of such apparently limited chances of making money — fine embroidered shirts and black cloth trowsers. The food of the peasantry is of the simplest character. Rye bread is a staple commodity, and sweet and butter-milk is used. Potatoes and onions are partaken of for dinner, to which, at times, a little ham or bacon is added." What domestic comforts might not the English peasantry enjoy with the same sobriety, economy, and attention to cleanliness!

The industry and foresight of the Flemish cottier farmers forms a striking contrast with the character of the same class in Ireland, in which every degree of wretchedness, discomfort, and thoughtlessness of the future combine with the most barbarous mode of cultivation to reduce the scale of domestic enjoyment to the lowest point consistent with humanity, and which is not the less painful to contemplate that the subjects of it seem scarcely sensible of its existence.

The Campine is the largest plain in Belgium, and embraces nearly the whole of the provinces of Antwerp and Limburg. The soil is one continuous covering of driving sand, twisted up by the eddies of wind into large mounds, or driven in clouds before it. In some parts it is thinly covered with heath or marshy plants intermixed with pools of water, stunted firs, or brushwood. Yet in this desolate and barren region the industry and perseverance of the Belgians have succeeded in reducing the apparently incorrigible waste to fertility; and here and there you meet with their little farms, fenced in by sand heaps from the surrounding desert, and smiling within its boundaries with verdure and brightness. These farms are multiplying continually, and bid fair, at no distant period, to convert the sterile desert into a garden, the howling wilderness into an abode of happiness and plenty. The chief means of effecting this important change is irrigation, which is greatly promoted by the numerous canals that have been constructed at a large expense. Extensive tracts of meadows have been formed, and roads are driven in every direction through the plain, from town to town, for the accommodation of the inhabitants, the canals being the common medium for conveying away the produce to, and bringing home the manure from, the different towns. Nothing, in fact could be effected without these two auxiliaries, as the Belgian farmers are well aware, whose motto is, "With the water, the grass; with the grass, cattle; with the cattle, manure; with the manure, everything nearly which one desires on a farm!" Since the formation of the Campine Canal nearly 5,000 acres have been brought under cultivation in the commune of Arendonck alone, where large farms have been established, and hundreds of head of cattle are fed, and dairies are formed. The value of the land in the Campine, where these improvements or creations have been effected, has risen from almost nothing to respectable prices. The best heath land, that sold previous to 1830 at 20 francs per hectare,* will now bring from 150 to 250 francs. Many of the richest gardens and

* About 6*s.* 9*d.* per acre.

most fertile farms in the neighbourhood of the towns of the Campine were, ten, twenty, and thirty years since, tracts of barren heath and the dreariest sand. Wherever manure has been easily obtained there it has been the most carefully preserved, and most prudently applied; and in the history of the facilities of obtaining abundant supplies of manure you read the history of the culture of the deserts of the Campine.

The soil of the Campine varies from a light white sand, through which the water filters as through a sieve, to a sandy loam. The former is planted in the first instance with fir-trees and broom, the *débris* of which, annually deposited, forms in time a vegetable mould, and consolidates the surface. Loam or clay is brought in aid, then manure, and thereby a crop of potatoes, or buckwheat, or rye is obtained. From this stage the process gains strength continually, until the defects of nature give way, and victory and success crown the efforts of the indomitable invader.

In some parts the yellow sand lies upon a hard crust called "tuf," and in England iron or moor-band pan, under which is a good loam. This is a more promising soil, but it involves the labour of deep trenching with the spade, to bring the loam and pan to the surface, when the frost is allowed to ameliorate them, after which they mingle intimately with the surface soil, and at once, with the addition of manure, form an excellent staple for cultivation. Potatoes are first taken, then rye with clover. The land is trenched upwards of twenty-seven inches (seventy centimetres) in depth with the spade, the turf being buried with the grass uppermost, to form in its decay a fertilizer for the future crop. The Campinoise farmers are said to excel even the Flemish in the collection and preparation of manures. All the cattle are stall-fed, and every description of vegetable capable of being reduced to manure is employed as litter, with which mould is also mixed to increase the bulk. The whole is kept under cover until it is wanted to be spread upon the land. An excellent compost for top-dressing the meadows is made by placing layers of vegetable earth on the stable floors to absorb the urine, to be afterwards mixed with other manure. The best rotation of crops recently introduced is as follows:—1st year, beetroot; 2nd, colza; 3rd, winter barley; 4th, rye with clover, or oats with do.; 5th, clover; 6th, wheat. This, however, is exceptional, as in general the cereal crops are too numerous, to the exclusion of root crops that require hoeing, so that the land is apt to become foul, which in some seasons materially affects and reduces the produce.

Rye is the principal cereal cultivated in the Campine. The seed is usually brought from a distance, and is sown at the rate of about 2½ bushels per acre. The average crop is about 24 bushels, but instances are related in which, by the application of an abundance of manure, as much as 74 bushels per acre have been obtained. Wheat has hitherto been an exceptional crop, but is now beginning to be generally cultivated, being rather more largely manured for than rye. The produce ranges from 20 to 28 bushels per acre. Barley is very little cultivated, but oats and buckwheat both form important articles of produce. The former yields from 33 to 66 bushels per acre; the latter from 28 to 33 bushels.

The distinguishing features in Flemish agriculture are the cultivation of manufacturing plants, as linseed, colza, and beetroot. The former is principally grown for the flax which it yields, and is manufactured into linen, one of the staple articles of industrial produce of Belgium. Of the colza there are several kinds cultivated, as the *colza d'hiver, colza d'été, navette, cameline,* and *pavot*; but the *colza d'hiver*, or winter colza, is the most general and may be grown on any soil, except a very wet one. It is a very productive crop, yielding from forty to forty-five bushels per acre. It is generally ready in June or July, and is frequently threshed on the ground in the open air. The plants are usually raised in seed-beds, and afterwards planted out. They are sown from July to August, and planted about the end of September. This operation is performed either with the spade or the plough. If the former is used it is thrust into the loosened soil and the handle pressed forward, which opens a square gap. At each corner of this a plant is put in. When the plough is employed, women place the plants in the furrow about ten inches apart, and the next turn of the plough covers them up. The cultivation of all the *brassica* kind of plants is nearly the same.

The beetroot is also a special object of the attention of the Flemish farmer, who calls it *une plante précieuse*, and with good reason, it being found equally valuable, whether as manufactured into sugar, or as food for cattle. In the former case the residue is found very nutritive as containing at least five per cent. of sugar, and it is sold to the graziers, or employed by the owners of the sugar works in fattening cattle and pigs. The kinds usually grown are the *rose à chair blanche* (red with white flesh), or *la blanche de Silésie* (the white Silesian). A sandy loam is the most favourable for growing it, although it is said that on a clay soil deeply tilled the per centage of saccharine is greater. Great improvements have been made in it in this respect, so that the proportion of saccharine matter has been largely increased. The cultivation of this plant is similar to that of the mangold-wurzel in England, which is so well known and understood that it is unnecessary to enter upon it here. They differ, however, from us in sowing the seed sometimes on a seed-bed and afterwards planting them out. In all cases the land is deeply tilled and heavily manured. The expense of cultivating a hectare of beetroot, according to M. Dombasle, including rent, is 324 fr. 25 c. (£13 10*s*.) or about £5 10*s*. per acre. The produce in 1859 averaged fifty tons per hectare, or about twenty tons per acre. But by the Koechlin method of cultivation, as much as 300,000 kilogrammes (or 295 tons) are said to be raised upon the hectare, or about 120 tons per acre. This is produced by raising the plants in a seed-bed manured heavily, and planting them out at the end of March or beginning of April, by which means they will have the full benefit of the spring and early summer's growth in advance. This Koechlin plan will be described more at length when we are treating of the cultivation of this tribe of plants in a future part of the work.

There is yet another tract of land in Belgium which possesses peculiarities that demand a passing notice. This is the *Pays Boisé*, or wooded country extending alongside of the Polder from Moerbeke to Ecluse. The subsoil of this district is composed of sand and decayed vegetable matter; the upper entirely of sand. It is liable to overflowing by the waters descending from the high grounds, and, like the Polder, has been brought into a state of fertility by the same energy and persevering industry of the inhabitants. Canals and ditches have been opened in all directions, dividing the land into narrow slips, and draining off the waters; these are partly cultivated, and partly left in wood. The course of crops occupies nine years, five of which the fields are under cereals, and the remaining four in green or root crops. Sometimes the land remains in pasture for three years at the end of the course, which, in any case, does not allow of much cattle being kept during winter.

The account here given of Belgian farming, as Mr. Burn remarks, shows that the principle on which it is conducted is what would be termed gardening in England; and it appears to be incompatible with the large farming of this country, on account of the great amount of hand-labour, as well as the large outlay of capital, it requires. Such however is not absolutely the case, for it is quite as possible to cultivate a farm of 100 or 1,000 acres as one of ten, upon the Flemish principles, especially with the aid of machinery possessed by the English farmer. And this facility will be largely augmented when the mission of steam power shall have been more and better understood in its application to the processes of the farm, which will then extend to the entire banishment of animal power from the practice of husbandry in its more severe labour.

SECTION X.

THE AGRICULTURE OF RUSSIA.

If we were to judge of the resources of the Russian empire by the extent of its territorial acquisitions, we should consider them almost illimitable and exhaustless, requiring only the stimulus of markets and the plastic hand of industry for their development. Defective as is the method of cultivation, and tedious as are the means for the transit of produce to the seaboard, yet so great is the extent of arable land on which to operate, that the proprietors can at any time extend their cultivation to meet the full measure of the demand. We have seen illustrations of the truth of this observation when the necessities of Western Europe have required a larger foreign supply than usual. On such occasions the grain, whether wheat or oats, is poured in a continuous stream into our ports from those of Northern and Southern Russia, the quantity only limited by the climatic and other natural obstacles that oppose themselves to the transport of the produce during the short summer. In fact, the grain is stored on the banks of the rivers in the interior, or in the granaries of the proprietors, until the favourable opportunity for the sale arrives; when, with all possible speed, it is sent forward for disposal.

Russia is naturally divided into three climatic regions—the cold, the temperate, and the hot. The cold region extends from 55° to 60°, north latitude, including Kasan, Moscow, Petersburg, and Riga; the temperate region lies between 50° and 55°, and includes a portion of Kiev, Saratov, Wilna, and Smolensko; the hot region reaches from 43° to 50°, and comprises Taurida, Odessa, Astracan, and part of the Caucasus, and of the district of Kiev.

According to Schubert, the Russian territory embraces an extent of 1,712,135,725 Prussian acres, distributed as follows:—

Forest and scrub	676,000,000 acres.
Unproductive	771,000,000
Arable	216,500,000
Meadow	24,500,000
Not accounted for	24,135,725
	1,712,135,725

Almost the whole of this immense country is a dead flat, the only high ground being the Oural range of mountains, which separate European Russia from Northern Asia; and that portion of the Carpathian range situated between Moldavia and Wallachia. The most valuable portion of the country in an agricultural point of view is a tract 65,000 geographical miles in extent, stretching in a broad belt from Volhynia, in a north-easterly direction to the foot of the Oural chain near Perm, and to the shores of the Black and Caspian Seas. The soil of this extensive tract is a rich black vegetable mould, varying in depth from three to five feet, and so productive as to need no manure and very little tillage. Its fertility is shown by the large returns it yields of grain, especially rye, and in the excellent breed of cattle reared upon it. So thinly is this fine country populated that a large portion of it is uncultivated. The farmers help themselves to portions of it, which they cultivate for cereals until the produce begins to fall off, when they abandon it and take a fresh portion.

The best cultivated parts are in Southern Russia; and the principal corn-growing districts are Podolia, Kiev, and Volhynia, and on the banks of the Don and the Wolga, the cereal land extending about 100 miles inland from the Black Sea and the Sea of Azov. The first three of these provinces contain together 70,750 square miles apportioned as follows:—

Podolia	20,450
Kiev	21,000
Volhynia	29,300
	70,750

These provinces partake of the same rich soil as part of the great belt mentioned above, and having an argillaceous and calcareous subsoil, are well adapted to every kind of agricultural produce. The land is divided into large estates held by boyars, or lords of high birth. Many foreigners, chiefly Germans, have had large grants of land at a small nominal rent, and on leases of 100 years and upwards, on condition that they and their descendants would reside upon and cultivate them. The German settlers or colonists are the most industrious farmers in Russia. They settle in communities, of which there are 118, called "crown colonies," the Czar having granted them tracts of land, and advanced them money to cultivate it. On the other hand they are not allowed to leave the country, but may dispose of their produce as they please. Most of them are become wealthy boyars, and are well satisfied with their position. They pay no rent the first year or two, after which they are charged three rubles (9*s.*) the *dessetina* of 5,600 square yards. The average produce of wheat in 1857 was $6\frac{1}{2}$ quarters per *dessetina*, or forty-five bushels per acre. These colonies are mostly in the southern and south-eastern governments of Russia, lying within a circuit of 100 miles diameter. The farms are distinguished by their superior cultivation.

There are no fences or walls to indicate the boundaries of the estates as in England or Ireland, but artificial mounds of earth are raised at certain distances; and the memory of these simple demarcations is preserved amongst the peasantry much in the same way as is practised in England in respect to parishes, by "going the bounds" of the estate with all the young people residing upon it. To impress the recollection of certain salient points of the boundaries, a stout, healthy lad is selected, thrown down upon the spot, and soundly flogged, amidst the laughter and jests of the assembled company. By this means the memory of the locality is retained for life, not only by the person thus roughly handled, but by all the young persons present. Many of the estates of the boyars are almost equal in extent to some of the German principalities. If you ask a proprietor what is the extent of his territory, he will measure it by the number of serfs he possessed, for these constituted its value in his estimation.

A large proportion of the land belongs to the crown, having been forfeited by the rebellion of the old proprietors during the Polish insurrections. Not more than one-fifteenth part of these provinces is cultivated. That which is under tillage, is let to farmers on leases of three, six, or nine years, which accords with the course of cropping practised, namely, 1st year, wheat; 2nd year, oats or barley; 3rd year, fallow. This is the general course of husbandry pursued, but sometimes where the land is farmed by the proprietor, it is cropped as long as it will bear a corn crop; and so rich are some parts that they have been sown with wheat upwards of twenty years consecutively. In these cases the land is seeded by the grain shelled in the previous harvest, and simply ploughed in two or three inches without any other preparation. It is said that better crops are obtained by this method than by a more elaborate tillage of the soil. The leases granted to the farmers are renewable at the expiration of the nominal term. After being regularly signed by both the contracting parties, and duly witnessed, they are registered in the local courts of the districts. It is the same in all contracts for, and mortgages and sales of, land, so that a title to property may at any time be satisfactorily proved by a reference to the register. The crown lands were formerly let thus on leases to farmers, but are now, to a large extent, converted into military colonies, and are cultivated not for immediate profit, but for the ostensible maintenance of that portion of the army stationed upon them.

Besides the boyar and the occupier or farmer of the land, the serf is an equally important, though more humble, member of the community, for so thin is the population of the rural districts, that the serfs constitute the most valuable property of the lord, or, at least, have done so hitherto, the measures of the present Czar for their emancipation having effected a great change in the relative position of both parties. The serf occupied a very different status from that of the English labourer. So far as his own will was concerned, he was irremovably attached to the soil or estate on which he was born, and could not leave it for an hour without the consent of his owner, or the demand of the government of his services for the army. A large portion of his time and labour must be given gratis for the cultivation of the estate, and he was liable to corporeal punishment at the caprice of his master only to the extent of five lashes at a time; but as an interval of half an hour was sufficient to render him liable to a repetition, the restriction was of little avail for the security of the serf. For military service he was always at the call of the emperor, but the selection of the levy demanded, rested with the owner, who did not always send away the best men for the purpose.

The serf was entitled by law and custom to a portion of land to the extent of three acres, which he cultivated for the support of himself and his family on those days when his labour was not required by his master. If drafted into the army, his little farm was cultivated by the females and younger sons of the family, as in Prussia. There were 42,000,000 serfs in the Russian empire, of whom 25,000,000 belonged to the emperor, so that, after all, his was the largest sacrifice by their emancipation. It is said that the crown serfs were more oppressed than those of the boyars, not that the sovereign himself was privy to their ill-treatment and oppression, but that, as a Russian expresses it, "God and the Czar are a long way off," in other words, the Czar, being compelled to delegate his authority over his serfs to others, knew nothing of the treatment, good or bad, that they were subjected to, according to the dispositions of the masters who were entrusted with the power over them. This in Russia was far more likely to be against than in favour of the serf. And this deduction is confirmed by the last census, which shows that on the crown lands the number of serfs was decreasing, whilst on those of the boyars it was increasing. By an ukase promulgated some years since, and called an "inventory," a considerable improvement was made in the laws relative to the serf. His allotment of land, which previously he was liable to have wrested from him when he had improved and cultivated it, he could afterwards hold by a kind of tenant-right, and the time when the lord could command his labour was more strictly defined, instead of being left to the caprice of his master.

The serf was subject to a capitation tax, which was levied upon every male in his family; if unable to pay it the lord was responsible for it; but before he paid it every means was resorted to to compel the serf to pay it. The last resource was to extinguish the cabin fire by bricking up the chimney, so that a fire could not be lighted without subjecting the family to the danger of suffocation from the smoke. This infliction in so severe a climate as that of Russia was attended with an amount of suffering we can form but an imperfect idea of. If it failed to extort the required sum the case was considered hopeless, and no further attempt was made. The system of serfage has been abolished by the present Czar, in spite of the most strenuous opposition of the boyars, which is not a matter of surprise. It naturally led to a great deal of injustice and cruelty, and afforded the owner or his representative, the steward or the farmer, the means of getting rid of an obnoxious or offending serf by sending him to the army. In such cases he was dragged from his home and family, his head was shaved on one side from front to back, heavy chains were riveted upon his limbs, and he was marched away with comrades in a similar condition, to the military depot.

The serf had a claim on his lord in case of old age, illness, or accident that disabled him from supporting himself and family, or if the head was drafted into the army. In all such cases they were generally so far provided for as to prevent absolute want; and these were frequently better off than those who depended on their own efforts, and who had sometimes to struggle against poverty and want in its most revolting form, when provisions were scarce and dear, or other circumstances lessened their ability to make the necessary provision for their support. Many of the boyars too were mild and humane in their treatment of the serfs, and in such cases there was no sacrifice the latter would not submit to for their benefit. The affection of the domestic serf to the children of the family was in some instances romantic, and in most a pleasing trait in their character. A remarkable instance of it is related in a small work from which we have derived a considerable part of our information.*

"I noticed," the writer says, "in one family that I visited, one of the nursemaids who attended on a child of the house, almost hideous. 'I am afraid that Mr. B. is not admiring our poor Teckla,' said the mistress of the house, laughing.—'Speaking frankly,' I replied, 'one's admiration is probably due to your attendant's intrinsic merit?'—'It is, indeed,' said the lady earnestly; 'and I am glad to have an opportunity of telling you so. Four years ago she was as pretty a girl as you are likely to see amongst our peasantry. Our house in the country took fire one night, and a considerable portion

* "Russians of the South," by Shirley Brooks, Esq., *Times* commissioner.

was destroyed, but everybody was saved, and, indeed, the person who had most to regret the accident was Teckla there. We were all standing looking at the fire, when it rushed into Teckla's brain that this child here, then a baby, was left behind in the burning house. She set up a wild shriek, which frightened us more than the conflagration had done, and sprang into the building through a window, the woodwork of which was in flames. Forcing her way through the smoke, she penetrated into one of the bedrooms, and there she must have fallen down overpowered. She was got out with great difficulty, and not until another side of the room, to which she had pushed, had given way; and she was discovered lying near a bed with the child's bed-cover in her hand: she must have madly snatched at that, and then dropped. She was dreadfully burned, and her life was despaired of, but she ultimately recovered, though disfigured as you see. Her own account is that she looked round for us all, missed the baby (who had been carried into a neighbouring cottage), and remembers nothing else.'"*

By an ukase of the present emperor the owners of the serfs were bound to grant them four *dessiaterns* (eleven Prussian acres) of land and a cottage in freehold, allowing them twelve years to pay for it, the value being fixed at £16 sterling. This was readily acceded to by the large landowners, who had far more land than serfs to cultivate it. But the case was different with the small proprietors, many of whom had not enough land to allow that quantity to each of the serfs upon their estates, and they were consequently compelled to purchase land for that purpose at a much higher price than that fixed by the ukase to be paid by the serf. It is impossible, indeed, in so large and sweeping a measure to avoid inflicting injury upon some persons; but of the general justice and humanity of the measure, and of the benevolence and rectitude of the emperor's intentions, there cannot exist a doubt, or that his object is to extend the benefits of civilization throughout his immense empire. In Siberia there were but few serfs, who belonged to the crown foundries, and these were amongst the first emancipated.

The cabins of the small occupiers of land are the counterpart of those of the Irish cottier farmers, except that the former are kept in better repair. Their mode of living is of the lowest description, rye or buckwheat bread, and sometimes bread made of the bark of a tree, supplying them with the chief portion of their subsistence. Wheaten bread is never eaten by them, and very little, if any, meat. "*Pot-au-feu* is found in every cabin, replete with the fumes of garlic, onions, and other savoury vegetables. Gruel made of buckwheat meal, 'thick and slab,' and flavoured with similar herbs, is a favourite dish with them. Water is the common beverage, but when they can procure the means, they are greatly addicted to intoxication."†

The three-shift course of cropping, which is so much practised, can only be tolerated in a country where both land and labour are cheap, and the former has a good staple. Even in Southern and Western Russia it is beginning to tell upon the productive power of the soil, which, like that of the United States of America, is found not to be absolutely inexhaustible. But the prejudices of the Russian farmers in favour of ancient customs, and their horror of the idea of spending money upon improvements, are

* Although the rule was for the lord to look upon the serf merely in the light of a valuable property or investment, many of the proprietors were kind and generous to them, especially on particular occasions. Harrison mentions an instance of this. "On one festive occasion," he says, "commemorating the saint's day of the young lady of the house, sixteen peasant couples were married, and received from their *barinn* (master) a horse, cart, and plough each."—"Notes of a Nine Years' Residence in Russia, from 1844 to 1853," by R. Harrison.

† Brooks.

unconquerable. The reply of a proprietor whose income was £16,000 a year, when advised to introduce a new machine upon his farm, was quite characteristic. "*Mon Dieu!* look at the expense! Why, you are asking me to lay out nearly sixty pounds! No, no; we will keep to the old plan."*

No manure is applied to the land, and to get rid of it, it is thrown upon the drift-ways. "Roads?" said a resident gentleman to Mr. Brooks—"No, we have no roads, not as the word is understood amongst yourselves, you English; or as in France, or anywhere but amongst ourselves. It would not answer. We have a more simple plan than to gather together materials and build a pathway, for it is really building to make these ways as they are generally made. Observe; we do not need them. Not, of course, that it is not necessary that our waggons, and carts, and carriages should have a path, but we can supply them without much trouble. Land is not so valuable with us but that we can afford more for our transit than those strips of ribands which you call roads in England, and which I have seen. The course is wide and open; if the waggons and carts tear it up, or the rains make it impassable in one place, it is easy to deflect a little to the right or left, and make out a fresh track. That costs nothing, so that we have very good paths after all."

"If ignorance be bliss," says the philosophic poet, "'tis folly to be wise." Certainly the logic of this resident gentleman is the philosophy of ignorance, for it is by such paths as these that the finest cereal produce of Europe, perhaps of the whole world, is conveyed to the shipping ports of the Black Sea, and on which the "carriages" of the Russian gentry perform their journeys. The same gentleman stated that it once required twelve bullocks to draw him and his family in their carriage out of a slough in the road. The passage of the corn-laden carts is at best very slow. With five sacks of corn on each cart, it takes them weeks to reach the depot; and as the bullocks have to subsist on the grass they find by the roadside, and what hay they can take with them, they are frequently distressed for want of fodder.

The land is cultivated, not in small enclosures, as in England, or in still smaller strips, as in France and Germany, but in extensive plains, stretching out as far as the eye can reach, a sea of undulating and waving corn of the richest verdure, whether of wheat, barley, rye, or oats. The labouring classes reside in villages, their condition being greatly ameliorated by the ukase of the present emperor for their emancipation.

The nature of the country, which is similar to that of the "rolling prairie" land of the United States of America, renders draining almost unnecessary. It is furnished, in most parts, with natural channels for carrying off the surface water into the brooks and streams. As to thorough drainage to relieve the subsoil from the springs, the Russian farmers are generally far from being sufficiently advanced to undertake it. Nor can we be surprised at this, when we reflect that in enlightened England there are many land-owners who hesitate to incur the expense, although they have the evidence of its utility and profitableness daily before their eyes.

The finest wheat is produced in these three provinces, and is either brought down the Vistula and other rivers to Dantzic, Konigsburg, and other ports on the Baltic, or down the Dniester to Odessa, or by land carriage to the same port. The wheat called Dantzic wheat is none of it grown in Prussia, but is the produce of the Polish provinces of Russia, conveyed to Dantzic during the short summer, and there laid in granary till

* Brooks.

a favourable opportunity occurs for its disposal. The species sown is chiefly spring wheat, because the mild, wet winters of the south-west are apt to cause the autumnal wheat to rot. "The general principle on which the husbandmen proceed is that much must be left to nature, and that her operations are neither seconded by great labour nor by refined industry." In fact, such is the raging fertility of the soil that the wheat straw is as tall and as stout as reeds, and the blades like those of Indian corn. The following is the state of progress in production in Russian Poland since 1822 :—

	1822.	1857.	
1 of wheat yielded	4	5	of the seed sown.
,, rye ,,	3	5	,,
,, barley ,,	3	5	,,
,, oats ,,	3	4	,,
,, peas ,,	2	6	,,
,, buckwheat	2½	3	,,
,, rape seed	5	5	,,
,, millet ,,	4	6	,,
,, potatoes ,,	4	7½	,,
Average		3·17	

The beet sugar manufacture was introduced into Russia some years since, and being encouraged by the government upon the ruling principle of selling much and buying little, has made great progress. Refined sugar chiefly is made, and such is the protection it is considered "necessary to award it, that the price is raised to 10*d.* per pound, and is therefore much above the means of the lower classes. The following will show the rate at which this manufacture has increased :—

Quantity made in 1849-50	3,628,170	lbs.	English.
,, ,, 1851-52	8,585,587	,,	,,
,, ,, 1854-55	12,150,000	,,	,,
,, ,, 1855-56	11,031,000	,,	,,
,, ,, 1856-57	15,377,000	,,	,,
Coarse sugar	13,636,000	,,	,,

The quantity of beetroot grown in 1858 was 350,000 tons, the average price of which was 24*s.* per ton, and the quantity of sugar produce in 1858-9; 33,600,000 lbs., which gives an average yield of not more than 4·3 per cent. This is very low, considering that in Northern Russia the beet contains as much as 13 or 14 per cent. of saccharine matter. Not more than 9,500,000 lbs. of the produce is consumed in the country, the rest being exported. It may be readily supposed that very little sugar is consumed by the labouring classes ; and, on the other hand, that they are heavily taxed to support the manufacture. If we estimate the natural price of the sugar at 6*d.* per pound, the difference of 4*d.* per pound upon the quantity made amounts to £560,000, and as there are only fifty-two factories in Russian Poland, the public pay £10,770 each annually for their support. The following is the consumption of sugar in different countries of Europe :—

England*	26 lbs. per head per ann.	
Belgium	17 ,,	,,
Holland	7¼ ,,	,,
France	6¼ ,,	,,
Switzerland	6½ ,,	,,
Poland	2 ,,	,,

* The average quantity imported in the seven years, from 1850 to 1856, inclusive, was 7,866,563 cwt., which allows 29 lbs. per head, reckoning the population at 30,000,000. From this must be deducted 3 lbs. per head for exported sugar. This calculation is exclusive of molasses, which is about 3 lbs. per head more

The quantity manufactured in other parts of Russia is about the same as in Russian Poland.

The Merino breed of sheep is diffused throughout the provinces of the Ukraine, and large quantities of fine wool are brought for sale to the fairs of Kharkoff and Poltava. In 1857 it amounted to 10,000,000, and in 1858 to nearly 22,000,000 lbs. which sold at about 1*s.* per pound. The breeding of sheep is much attended to in the Ukraine, where rich pasturage abounds. The steppes, which are the most remarkable feature in the geography of Russia, commence about 100 miles in the interior, from the shores of the Euxine, and cover a vast extent of country. They are for the most part unfertile, being chiefly sand, in some parts mixed with salt, and in others wholly destitute of water, whilst others are covered with swampy marsh and stunted birches. The most notable exception to this description is the Baraba Steppe, in the government of Tomsk, in Siberia, where a large quantity of corn is raised on the banks of the Obi and the Kama, near Barnoul. The land is sometimes cropped with cereals for many years in succession without the application of any manure. The produce is taken down the Obi for shipment at the port of Sobski or Borozof, and thence, by the Gulf of Obi, to the European markets when it is required.

The Russo-Danubian provinces of Moldavia and Bessarabia were wrested from Turkey by the treaty of Bucharest, at the close of the war in 1812. By this treaty it was stipulated that Russia should retain that part of Moldavia situated to the north of the river Pruth, which takes its rise in the Palatinate of Marinarosch in Hungary, and flows through the Bukovine, falling into the Danube a little below Galatz. This arrangement gave to Russia the north bank of that river from the junction of the Pruth, and the command of the Sulina entrance from the Black Sea. According to the terms of the treaty, Russia is bound to keep this passage of the Danube free from mud and other obstacles that naturally accumulate at the junction of its waters with those of the Euxine; but, with the design of favouring the trade of Odessa, she has greatly neglected that duty, which constituted a just ground of complaint against her previous to the Crimean war.

The eastern part of Moldavia and Bessarabia is of a similar character with that of Ukraine, consisting of extensive undulating alluvial plains clothed for the most part with luxuriant verdure. Formerly not more than a fortieth part of the land proper for cereal crops was under cultivation; but of late years a large extent has been brought under the plough for corn growing, leaving still, however, abundant pasturage for great numbers of cattle, sheep, and horses, which thrive well upon the rich grass. The horses have the Arabian blood in their veins, and excel both in strength and speed. The sheep are mostly a cross breed between the native sheep and the Merino, and produce wool of a good staple. The cattle have had no attention paid to them, being of the native unmixed breed, preferred more on account of their size than their symmetry of form, smallness of bone, or quality of meat. The cereal products are wheat, barley, maize, millet, tobacco, wine, &c. These, or rather the surplus, are taken by way of the Black Sea to the islands of the Mediterranean, or the ports of Western Europe, when the markets are open, and the price is remunerative.

The western confines of Moldavia consist of a succession of hills and valleys of great beauty, branching from the Carpathian range of mountains, which separate the province from that of Transylvania. The whole of this tract is rich and fertile, but the oppression of the Turks and Russians, who possess the two sections of the country, is an effectual bar to industry and progress. The cultivation is of the most rude and slovenly description, but so great is the fertility of the soil, that very little culture is required to produce an abundant crop.

Bessarabia lies eastward between Moldavia and the Black Sea. It resembles Moldavia in all its natural features, and in its productions. The town of Ismail is situated in this province, on the north bank of the Danube about thirty-three miles from its mouth. This town is memorable in history for its siege by the Russians in 1790. The human butcher Suwarow commanded the besiegers, and having taken it by assault, after a brave and determined defence, put twenty thousand of the inhabitants to the sword, and sent the rest, ten thousand, into slavery. He then coolly wrote his celebrated laconic despatch to the empress: "Madam, the proud Ismail is no more!" Bessarabia is joined to the small province of Budziac Tartary, which was colonised in 1569 by Tartars from the banks of the Wolga. Both these provinces formed part of the Turkish empire until the year 1812, when, with part of Moldavia, they were finally ceded to Russia. They contain about 8,800 square miles (5,632,000 acres), and their agricultural produce is in all respects similar to that of Moldavia.

Lying at the farthest southern extremity of the empire, these three provinces share but little in even that scanty degree of civilization which the government of the czars has hitherto permitted in its other provinces. Education is at a very low ebb, and the population being a mixture of Turks, Poles, Jews, Tartars, Greeks, &c., each tribe follows its own form of religion, although the Greek faith is encouraged by the authorities. Situated at the outskirts of the Russian power, they are sure to be the theatre of war in a contest with either Turkey or Austria. It matters little to the oppressed inhabitants whether in such cases the country is occupied by friend or foe, for the fatal effect is the same; and they have not yet recovered from the devastations committed by the Russian troops during the progress of the late war.

Being comparatively recent acquisitions of Russia, the people can scarcely be considered strictly as belonging to the Sclavonic race, although subject to all the political influences, for good or for evil, of the imperial sway. Borne down by oppression in the past, and hopeless of any change for the better in the future; without moral instruction to elevate their character, and degraded by a superstitious form of religion, which never reaches the heart or rectifies the conduct, the people are immoral, ignorant, and brutal, and in intellectual attainment but little elevated above the cattle they tend. The Mahometans are probably the most enlightened, which is saying little in their favour. What superiority they possess is owing to their commercial relations with Turkey; in other respects there is but little difference. Ground down, as they all are, by the extortion and tyranny of the government officials, they have no stimulus to, or even ideas of, improvement in any of the occupations or affairs of life.

The most enlightened and best cultivated districts of Russia are the provinces of Courland, Esthonia, and Livonia, where the cultivation of the soil is conducted on somewhat better principles, and the results are seen in the better arrangement of the agricultural operations, and the greater regularity of the crops. Agricultural societies have been established, but they are under the strict surveillance of the authorities; and so jealous is the government of any political bias which these institutions are supposed to involve, that they are subjected to restrictions which to a large extent frustrate their object. We have very recently seen the agricultural society of Warsaw broken up, because it was believed by the government to foster the principles of Polish independence and nationality.

The chief natural difficulties under which Russian agriculture labours is, the scarcity of population, the want of roads, and the short time that the rivers remain open and free from ice in the northern and eastern provinces, where it frequently requires two summers to convey the produce to the ports of the Black Sea, or to Archangel in the White Sea. The Obi and the Don are connected by a canal, which greatly facilitates the transit either north or south so far as the climate will admit; but the flatness of the countries through which these rivers flow, and the existence of shifting sandbanks by which the navigation is obstructed, and whose ever-changing position renders the corn-laden boats continually liable to get aground, occasions their progress to be very slow and interrupted. The Russian sovereigns are quite aware of these disadvantages, and are endeavouring to remedy them by the construction of railroads through the heart of the country. It will require many years to carry out this project, so far as to facilitate the intercourse between the interior and the coasts, either north or south,* and the thinness of the population will still remain an obstacle to extended cultivation and good husbandry.

It has been the policy of the Russian government to induce foreign agriculturists, and especially from England or Scotland, to settle in Russia, in order to introduce the system of husbandry practised in their own countries. We believe, however, that most of those who have been tempted to accept the invitations have been glad to get back again. And as it is the established policy of the Russian authorities not to let any money leave the country if they can possibly prevent it, these foreigners have found themselves little the better for their speculation. A good many Germans, as we have stated before, have settled in Russia and are thriving, being much less addicted to liberal ideas than the subjects of the British crown, and consequently more easy under the absence of freedom. These men have introduced many of the modern improved machines of Western Europe; but at present their adoption has not made much progress amongst the native farmers. In a large portion of the arable land, from Archangel to Odessa, the light fork one-horse plough, a wooden-toothed harrow, and the reaping-hook, are the only implements used in tillage. The soil is stirred to the depth of two inches and sown, and the seed then harrowed in; after which it is left to the goodness of Providence, the soil, and the weather.

With such treatment the produce in some parts is perfectly astonishing. In Livonia and Esthonia the yield of wheat is from ten to sixteen fold; on the Don, ten to fourteen; on the Obi and Tom, twenty-five to thirty. At Krasnayarsk the failure of a crop was never known, although they sow the land with the same grain fifteen consecutive seasons. It is remarkable that, in the eastern provinces, no seeds of weeds are ever found in the wheat that is exported; and it is said that no weeds ever grow among the corn. The grain is generally threshed out in the field or barn-yard with the flail; but in some of the northern Baltic provinces the threshing-machine has been introduced

* In a recent debate on the corn laws of France, a member of the French legislature declared that Russia could grow enough wheat to export 60,000,000 quarters annually, and thus swamp the agriculture of western Europe. But it was shown, on the other hand, that it is physically impossible, with the present population, in so extensive a country to increase the cultivation much beyond the wants of the people, and that it can only increase in proportion with the local demand and consumption.

with great effect. Harrison mentions an instance in which 28,000 sheaves of wheat were threshed, winnowed, and stored in granary, in one day, on an estate numbering eight villages. When thus prepared, it is laid up in wooden warehouses, on the bank of a river, ready for exportation, which is effected in heavy barges to the shipping ports of the Baltic, the White, or the Black Sea, according to the facilities afforded by the rivers or canals.

A school of agriculture has been instituted at Gorygoretzk (a domain of the crown), near Mohilow, at which 120 young men are constantly under a course of instruction to qualify them for assuming the management of large estates. This will, in time, have an important effect upon the agriculture of the country, and, coupled with the emancipation of the serfs, and the spread of education, which the present Czar is desirous of promoting, will tend to raise the rural classes from their present state of degradation. The task, however, that the Czar has undertaken is a herculean one; and it will require all the energy and decision the human mind is capable of to carry it out to a conclusion against the powerful opposition of the Russian landed aristocracy, whose property, as well as prejudices, are invaded by it, and whose antecedents would lead to the supposition that they will not quietly surrender their privileges.

It is evident, upon a review and examination of the agricultural resources of Russia, that the southern provinces of that empire are the grand resources from whence the markets of Western Europe must look for a supply of cereal produce; but it is a question whether the production of wheat can do more than keep pace with the increasing demand abroad, and the requirements of the increasing population at home. By way of the Vistula, it does not appear there has been any great increase, although the quantity fluctuates from year to year. Thus, for the three years 1855 to 1857 the following was the entire export of the grain from Russian Poland by way of the Vistula:—

1855 . . .	79,577 qrs.	average 118,443 qrs.
1856 . . .	104,705 ,,	
1857 . . .	171,047 ,,	

The entire quantity harvested in that country in the latter year was only 1,582,464 qrs. From Riga, brought down by way of the Dwina, the average export of wheat in eight years, from 1846 to 1853 inclusive, was 10,290 qrs., whilst that of the years 1854 and 1857 was only 4,639 qrs. From Archangel, the average of five years was 15,164 qrs., and of oats for the same period 204,012 qrs. From the ports of the Black Sea and the Sea of Azov a greater quantity is exported. At Odessa, in 1853, there happened to be a large accumulation of wheat, which enabled her to export 2,160,000 qrs., but this was an exceptional year; and in 1857 the exports were only about 800,000 qrs. From the Azov ports, and Taganrog, the quantity exported in 1857 was 994,511 qrs., of which the port named, which lies at the mouth of the Don and receives the produce sent down that river, exported 760,000 qrs.

A large quantity of grain is annually destroyed by the slovenly manner in which it is kept. Generally it is not housed, but temporarily stacked, and, after harvest, trodden out by horses and bullocks as speedily as possible, and conveyed to the port to be shipped. What remains after the end of October is buried underground, and left there till March, to make up the spring cargoes.* The great want in Russia is roads, those

* Blue Books for 1859. Statistics of foreign countries.

which exist being impassable after twelve hours' rain. They are generally from 100 to 120 yards in width, but are just in the state in which nature left them. A line of railway is in progress from Moscow to Taganrog, Marianople, &c., which will facilitate the conveyance of produce and increase the value of land.

SECTION XI.

AGRICULTURE OF THE UNITED STATES OF AMERICA.

In some respects the characteristics of the land of the United States are similar to those of Russia. In both these countries there are still immense tracts of level virgin soil of the richest description unoccupied; and in both the population is so thin, as to render it impossible generally to cultivate, in a proper manner, that which is under tillage. In America, as in Russia, the cultivator has "the world all before him where to choose;" and in the new western states, so fertile is the soil, that he can hardly choose amiss. Nor do the young eastern farmers hesitate to avail themselves of this facility for acquiring fresh land, when by a scourging system their old farms are exhausted. The system, however, though individually profitable, is ruinous to the country at large. All the old eastern states, conveniently situated for easy access to the seaboard and the European market, are fast becoming exhausted, worn out, and going out of cultivation. In some of the New England states cereal produce, except Indian corn, has almost ceased to be cultivated, although, from being the principal seat of textile manufacture, a profitable market exists for all kinds of agricultural produce. The "Year-Book of American Agriculture," for 1856, has the following passages on this subject:—

"The constant deterioration of the soils of New England, and throughout most of the agricultural districts of the United States, is a fact of portentous and alarming significance, though it has not yet arrested very extensively the public notice. Probably there is no one fact in our agricultural economy of more pregnant interest than this, in its bearings upon our future prosperity. . . . Between 1840 and 1850, 300,000 acres of land were added to those previously under improvement in Massachusetts: 90,000 acres were added to our mowing lands, and yet there was a relative depreciation of the hay crop, during that decade of years, of 12 per cent. Our tillage lands, during the same term, were increased 40,000 acres, and yet there was an absolute depreciation in our grain crop of 6,000 bushels. The pasturage lands were increased more than 100,000 acres, with scarcely any increase of neat-cattle, and a reduction of 160,000 sheep, and 17,000 swine.

"The same law of deterioration is observable in the richer regions of the south and west, showing that, with our present unskilful modes of farming, we are taking much more from the productive ability of our soils than we are returning to them, and that our agricultural prosperity is really and constantly on the wane. This downward tendency is partially hidden from public observation by the vast products that are raised upon the new and almost limitless regions which are every year put under cultivation in the west; but the fact itself is undeniable.

"In the state of New York, between the years 1845 and 1850, 671,692 acres were added to those previously under improvement, and of course there ought to have been at least a corresponding increase in the agricultural products of the state; but what was the fact?

The number of horses decreased is 58,141.
Milch cows decreased 63,066.
Of other cattle, the decrease was 127,525.
Of sheep, the decrease was 2,990,622.
Of swine, the decrease was 556,002.
Of potatoes, the decrease was 7,255,066 bushels.
Of peas and beans the decrease was 1,132,054 bushels.
Of flax, the decrease was 1,956,485 pounds.
Of wool, the decrease was 3,793,527 pounds.
Of wheat, the decrease was 270,724 bushels.
Of buckwheat, the decrease was 450,724 bushels.

There was an increase in the amount of corn (maize), rye, oats, barley, hay, butter, and cheese raised in that state, but no greater than would have been expected from the increase of the population, which was 494,323 during those five years."*

The same deterioration is stated to have taken place in Tennessee, Kentucky, Virginia, and even in the comparatively new states of Wisconsin, Illinois, &c. In New York State, the decrease in the wheat crop alone is 25 per cent.; but, on the other hand, that of Indian corn has increased nearly 100 per cent. All the above figures are taken from the accounts of the Patent office, and are as correct as any American statistics that are published. The following is the account of the actual acreage produce of different states, quoted from the census of 1850 by Mr. Jay, in an address before the American Geographical and Statistical Society:—

1. WHEAT PER ACRE.

	Bushels.
Alabama and Georgia	5
North Carolina, Virginia, and Tennessee	7
New York, Indiana, and Ohio	12
Maryland and Vermont	13
Iowa and Wisconsin	14
Florida, Pennsylvania, and Texas	15
Massachusetts	16

2. RYE.

Virginia	5
Georgia and Tennessee	7
New Jersey	8
New York	17
Ohio	25

3. OATS.

North Carolina	10
Mississippi, South Carolina, and Alabama	12
Virginia	13
Arkansas, Georgia, and Kentucky	18
Delaware, Indiana, and Maine	20
Connecticut, Maryland, and Ohio	21
Pennsylvania	22
New York	25
Vermont, New Jersey, &c.	26
Illinois	29
Wisconsin	35
Iowa	36

4. INDIAN CORN PER ACRE.

	Bushels.
South Carolina	11
Alabama	15
Georgia and Louisiana	16
North Carolina	17
Mississippi and Virginia	18
New York and Maine	27
Vermont and Iowa	32
Indiana, Illinois, and New Jersey	33
Missouri	34
Ohio	36
Connecticut	40

5. IRISH POTATOES.

North Carolina	65
Maryland, Ohio, New Jersey, and Pennsylvania	75
Indiana, Iowa, New York, and Rhode Island	100
Maine and Tennessee	120
Kentucky	130
Michigan	140
Massachusetts	170
Florida	175
Vermont	178
New Hampshire	230
Texas	250

It is a common saying, that an English practical farmer, on going to America to

* "Year-Book of American Agriculture," 1855-6, p. 214.

farm, must leave behind him his preconceived ideas of good husbandry, and just conform his practice to the conditions of the country to which he has emigrated. This is correct enough, so far as the occupation and breaking up new land is concerned. In clearing a portion of the forest, and bringing it into cultivation, it would not simply be absurd, it would be impossible, to adhere to a systematic course of treatment of the soil, analogous to that which is necessary at home. Even after the timbers are felled and burned, the stumps remain for years before they are sufficiently decayed to be easily removed; and then the rich vegetable mould has to be broken up and consolidated before it can become the fit seed-bed for wheat, or manure be employed without rendering the soil too rich. Nothing can exceed the cheerless, isolated, and unpromising appearance of a settler's *clearing* in the midst of the primæval forest. The "owner" looks not unlike a person struggling for existence on a single plank in the middle of the ocean. For weeks, often for months, he sees not the face of the stranger. The same still, and wild, and boundless forest every morning rises up to his view; and his only hope against its shutting him in for life rests in the axe upon his shoulder. A few blades of corn peeping out between stumps whose very roots interlace, they are so close together, are his sole safeguards against want, whilst the few potato plants, in little far-between "hills," and which struggle for existence against the briar-bush and luxuriant underwood, are to form the seeds of his future plenty. Tall pine-trees, girdled and blackened by fire, stand out as grim monuments of the prevailing loneliness, whilst the forest itself, like an immense wall round a fortress, seems to say to the settler, "How can poverty ever expect to escape from such a prison-house?"*

Such is the first life of a settler in America, and so rough and unpromising were the materials out of which have sprung those prosperous communities that now cover the surface and cultivate the boundless resources of the Western World. It is evident that there is no room or need for the display of agricultural skill or knowledge in this contest for existence with the dense and frowning forest. The "settler" cannot become a "farmer" for years after his first entrance upon his laborious life. The misfortune is, that in the United States, so many who have attained the character of the "farmer," still retain the ideas and practices of the "settler." The land which, from the generous nature of the soil, yielded crop after crop without manure, and with but little tillage, is expected to retain its productive power, or at least, is subjected still to the same exhausting system, the result of which is to be found in the quotation with which we have commenced this section. "That is a fine field of wheat," said a friend of the writer's, in passing down the Ohio in a steamboat, to a gentleman who had just before got on board. "Yes," he replied; "that field is mine, and it has been cropped with wheat without manure for *twenty-five consecutive years*, and has never once failed." Such is the practice with the generality of the farmers in both the old and new states. We heard of a substantial emigrant who recently purchased a farm that had long been under cultivation; and one motive for selecting it was, that there was an accumulation of fifteen years' manure of the farm upon it, none having been applied in all that time by his predecessor.

The great obstacle to good farming in America is the scarcity of hands, and the consequent dearness of labour. This was the case from the first settlement of the country, and must necessarily be so, whilst there is so much good land easily attainable.

* "Canada," an Essay, by J. S. Hogan.

Sir John Sinclair, the President of the Board of Agriculture, wrote to President Washington, asking how it was that the rich lands of America did not yield more than eight bushels of wheat per acre? The reply of the latter was, that "land was so cheap, and labour so dear, that it was more profitable to cultivate a large quantity of land badly, than a small quantity well." The same principle is acted upon to the present time. Owing to the large quantity of fresh land continually brought under cultivation, and the number of hands absorbed by commerce, navigation, railways, manufacture, migration to California, &c., the proportion employed in agriculture does not exceed one man and two-thirds to every two hundred acres of arable land under cultivation; and it would appear that this proportion is continually decreasing, for Mr. Jay, in the paper already quoted, states that by the census of 1840, the portion of the adult male population employed in agriculture amounted to 77·4 per cent., whilst in the census of 1850 it was only 44·69 per cent. Other writers corroborate this statement. Russell, in the account of the farms he visited, speaks of a farmer in Illinois who possessed 1,200 acres, which he divided amongst his children, giving 140 acres to each, on which they kept one man and two horses, who, with the master, performed all the labour of the farm. He also mentions the president's farm in Michigan, of 160 acres, on which two young men cultivate and harvest sixty acres of wheat, sixty of Indian corn, and do all the other work of the farm.

The total amount of "improved" or cultivated land in 1850, according to the census, was 113,032,614 acres, divided into 1,449,075 farms and plantations. The unimproved lands comprise 180,528,000 acres. Taken together, they allow 202 acres to each farm on the average, valued at 2,250 dollars each. The following is the average size of the farms in the different states, according to the same authority:—

	Acres.		Acres.		Acres.
Maine	97	Maryland	202	Louisiana	372
New York	120	Kentucky	221	Georgia	441
New Jersey	113	Tennessee	267	South Carolina	541
New Hampshire	115	Virginia	340	Texas	942
Pennsylvania	116	North Carolina	369	California	4466
Ohio	125	Mississippi	309		

The value of the occupied land ranges from $1\frac{1}{2}$ dollar per acre in Texas to 28 dollars in the middle states. The southern states do not average more than $11\frac{1}{2}$ dollars per acre; the north-western, $20\frac{1}{4}$ dollars; so that in the middle states land is the most valuable. All these are proximate estimates, and must be taken as such; they, however, afford an insight into the construction of the land system in America, and will assist the reader in forming a tolerably clear notion of the distribution of the soil.

It appears to us, that the great defects in the character of American agriculture arise from a want of that attachment to the soil on the part of the occupiers or owners which in older countries renders the permanent possession of a property an object of anxious desire and effort. For instance, a youth of seventeen or eighteen years of age leaves the paternal roof, and with a few dollars takes or purchases a tract of land in a wild state. This he brings under partial cultivation, and then seizes the first favourable opportunity to dispose of it, and goes further back westward to repeat the operation. Many occupy farms and work them as long as the cultivation will produce a profit; and then either abandon them altogether, or, if fortunate enough to find purchasers, dispose of them on the best terms they can obtain, and go westward. Large tracts of land in Virginia and other of the eastern states have been thus reduced to sterility, and abandoned, to return to the state of nature they exhibited when the country was first discovered. A period will probably arrive when they will again become an object of speculation to settlers. It has been predicted by intelligent men in the states, that unless a change is made in the management of the land, America will, in fifty years, require importations of bread-stuffs instead of being an exporting country. This is probably too gloomy a view to take of the question, because it is scarcely probable that in that period the immense tracts of virgin land will have been taken, let the increase of the population be what it may.* It is calculated that the valley of the Mississippi alone, if all brought under tillage, would support more than 50,000,000 inhabitants. This enormous tract contains 1,217,562 square miles, or 354,071,480 acres, a large proportion of which is a deep alluvium of almost inexhaustible fertility, and having the Mississippi and its numerous tributaries for outlets for its products, as well as for its drainage. A rich narrow belt, on both the east and west side of the river, reaches from its source to its junction with the Mexican Gulf. Beyond the ninety-eighth meridian of longitude, westward to the Rocky Mountains, and from thence to the Pacific, with the exception of a narrow strip next the coast, the land is for the most part barren and unfit for the support of a civilized community.†

It is calculated by the most competent authorities that not more than one-thirteenth part of the United States' territory is "improved" or cultivated, about one-eighth more being occupied but not cultivated; and the entire number of acres occupied is, in round numbers, 300,000,000, or one-sixth part of the national domain.‡ The writer from whom we have quoted, combats the theory of Ricardo and Malthus, that the first settlers selected the best land, and asserts, on the authority of Carey, that millions of acres of the richest portions even of North Carolina still remain uncleared, whilst labour and capital are both expended upon soils that do not yield more than three, four, and five bushels of wheat to the acre; and that the same is true of South Carolina, Georgia, Florida, and Alabama. The fact probably is, that the first settlers selected their land on account of some supposed local advantages,—as the vicinity to the sea-coast or a river, or exemption from the attacks of the Indians. But why the richest lands should still remain unoccupied in the older states is difficult to say. So entirely valueless are the richest lands of the west, south, and south-west, that Congress has recently granted them, to the extent of nearly 40,000,000 acres, to the states in which they lie, and the latter have accepted them.§

* Taking the difference between the census of 1840 and that of 1850, the increase of the population is about 35 per cent. As this increase proceeds in a compound ratio, if we take the round number in 1850 to be 23,000,000, the decennary numbers at the same rate will be as follows:—

1860	31,050,000
1870	41,917,500
1880	56,588,625
1890	76,394,635
1900	103,132,745

A large proportion of this increase is caused by emigration, and it is a question whether the natural increase of the population in America is equal to that of England. It is also probable that the state of affairs in the United States will put a stop to emigration for some time, as well as to the natural increase. A large number of emigrants are already returning to Europe, but we believe these are chiefly unsettled persons, having acquired no land in the states.

† Jay's "Address," p. 30. ‡ Ibid., p. 31. § Ibid.

The four great staple articles of agricultural produce are Indian corn, wheat, cotton, and hay; and the statistics of these, in 1850, were as follows:—

	Number of acres.	Produce in bushels.	Value of crop.	Produce per acre.	Value per acre.
Indian corn . .	31,000,000	592,071,104	$296,035,552	$19\frac{1}{10}$ bushels.	$9·55
Wheat	11,000,000	100,485,844	90,437,260	$9\frac{1}{8}$ "	8·21
Cotton	5,000,000	978,317,200 lbs.	78,265,376	$195\frac{1}{2}$ lbs.	15·64
Hay	13,000,000	13,838,242 tons.	138,382,420	$1\frac{1}{16}$ tons.	$10·62\frac{1}{2}$

The Indian corn is stated by Mr. Jay to be the only species of produce that has not retrograded, it having increased from 1840 to 1850 nearly 56 per cent., whilst wheat, according to the census, had increased only 15 per cent., although the population had increased 35 per cent., and notwithstanding the large extent of new land brought under cultivation. So far as the supplying of the population with food, the latter result is of far less consequence in America than it would be with us, because national habit and taste would lead them to fall back upon Indian corn, if the wheat crop should fail. At the same time, it proves the deterioration of the soil in the older states, where the production of the most valuable article of culture does not near keep pace with the increased breadth of land brought under tillage. In New York state alone, the wheat crop, which in 1840 was 12,286,418 bushels, was in 1855 only 9,092,402 bushels, being a falling off of more than 25 per cent. Tobacco also has fallen off in the same period from 219,163,319 lbs. to 199,752,655 lbs., being a reduction of nearly 9 per cent.

Mr. Morrell, member of congress for Vermont, affirms that agriculture is declining rapidly in every state of the Union; that the quantity of food produced bears, each year, a smaller proportion to the number of acres under cultivation; and that over a very wide area some of the most useful crops bid fair to become extinct. This opinion Mr. Jay thinks is erroneous, because the total amount of produce, including Indian corn, does not bear out the fact. He admits, however, that "as productiveness of crop and destructiveness of soil are said to be the two prominent features of American agriculture, the large harvests in our young states ought not to blind us to the fact, *that the fertility of those parts of the older states, which once yielded as abundantly, seems to have been steadily diminishing for a long course of years.*" This admission justifies rather than confutes Mr. Morrell; and the fact that, in the comparatively young states of Indiana and Wisconsin, Indian corn has fallen off in produce from sixty to forty bushels per acre in the former, and wheat full 50 per cent. in the latter, in twelve years, still further strengthens it.

The following figures show the increase of animal products in the ten years from 1840 to 1850:—

	1840.	1850.	Increase.
Horses	4,336,269	4,896,650	560,381
Neat cattle	15,000,000	18,378,907	3,378,907
Sheep	19,500,000	22,000,000	2,500,000
Swine	26,300,000	30,300,000	4,000,000
Wool . . . . lbs.	35,802,114	52,516,959	16,714,845
" average weight of fleece . . .	1·84	2·43	·59

Butter produced in 1850 . .	313,266,962 lbs
Cheese	105,535,219 "

The total value of the live stock in 1855 was about 550,000,000 dollars; and of the animals slaughtered, 11,750,000 dollars.*

Great attention has been paid of late years to the improvement of the various breeds of cattle and other animals in the United States. No expense has been spared to purchase the best types of the various species in England, and these, on being imported, have generally succeeded remarkably well, so far as the horses, cattle, and swine are concerned; but less so in the case of the sheep, which appear not to maintain the superiority they possess on importation. There is, in fact, no good mutton to be had in the states, which is probably owing to the quality of the food. The short-horn breed of cattle are quite equal to those of the best herds in England, from which they are descended.

The great mart for the rearing, fattening, and curing of swine is Cincinnati, in Ohio, where the slaughtering of them is reduced to system by a singular division of labour. The following account, taken from the "Year-Book of American Agriculture" for 1855-6, will be found amusing and instructive:—

"The building and appurtenances are calculated for despatching two thousand hogs per day. The process is as follows:—The hogs being confined in pens adjacent, are driven, about twenty at a time, up an inclined bridge or passage, opening by a doorway at top into a square room, just large enough to hold them; and as soon as the outside door is closed, a man enters from an inside door, and with a hammer of about two pounds' weight and three feet length of handle, by a single blow, aimed between the eyes, knocks each hog down, so that scarce a squeal or grunt is uttered. In the meantime a second apartment, adjoining this, is being filled; so the process continues. Next, a couple of men seize the stunned ones by the legs, and drag them through the inside doorway on to the bleeding platform, where each receives a thrust of a keen blade in the throat, and a torrent of blood runs through the latticed floor. After bleeding for a minute or two, they are slid off this platform directly into the scalding vat, which is about twenty feet long, six wide, and three deep, kept full of water heated by steam, and so arranged that the temperature is easily regulated. The hogs being slid into one end of this vat, are pushed slowly along by men standing on each side with short poles, turning them over, so as to secure uniform scalding, and moving them onward, so that each one will reach the opposite end of the vat in about two minutes from the time it entered. About ten hogs are usually passing through the scalding process at a time. At the exit end of the vat is a contrivance for lifting them out of the scalding water, two or three at a time, unless quite large, by the power of one man operating a lever, which elevates them to the scraping table. This table is about five feet wide, and twenty-five feet long, and has eight or nine men arranged on each side, and usually has as many hogs on it at a time, each pair of men performing a separate part of the work of removing the bristles and hair. Thus, the first pair of men remove the bristles—only such as are worth saving for brushmakers, taking only a double handful from the back of each hog—which are deposited in a barrel or box. The hog is then given a single turn onward to the next pair, who, with scrapers, remove the hair from one side, then turn it over to the next pair, who scrape the other side. The next scrape the head and legs; the next shave one side with sharp knives; the next do the same to the other side; and the next, the head and legs; and each pair of men have to perform their part of the work in

* Jay's "Address," p. 44.

only *twelve seconds* of time, or at the rate of *five hogs in a minute*, for three or four hours at a time! Arrived at the end of this table, with the hair all removed, a pair of men put in the gambril-stick and swing the carcase off on the wheel. This wheel is about ten feet in diameter, and revolves on a perpendicular shaft, reaching from the floor to the ceiling, the height of the wheel being about six feet from the floor. Around its periphery are placed eight large hooks, about four feet apart, on which the hogs are hung to be dressed; and here again we find remarkable despatch secured by the division of labour. As soon as the hog is swung from the table on to one of those hooks, the wheel is given a turn of one-eighth of its circuit, which brings the next hook to the table, and carries the hog a distance of four feet, where a couple of men stand ready to dash on it a bucket of clean water, and scrape it down with knives, to remove the loose hair and dirt that may have come from the table. The next move of the wheel carries it four feet farther, where another man cuts open the hog almost in a single second of time, and removes the large intestines, or such as have no fat on them worth saving, and throws them out at an open doorway by his side; another move of four feet carries it to the next man, who lifts out the remainder of the intestines, the heart, liver, &c., and throws them on to a large table behind him, where four or five men are engaged in separating the fat and other parts of value; another move, and a man dashes a bucket of clean water inside, and washes off any filth or blood that may be seen. This completes the cleaning or dressing process, and each man at the wheel has to perform his part of the work in twelve seconds of time, as there are only five hogs at once on the wheel, and this number are removed, and as many added, *every minute*. The number of men employed, besides drivers, outside, is fifty; so that each man may be said to kill and dress a hog every ten minutes of working time, or forty in a day. This presents a striking contrast with the manner that farmers generally do their hog-killing. At the last move of the wheel, a stout fellow shoulders the carcase, whilst another removes the gambril-stick, and backs it off to the other part of the house, where it is hung up for twenty-four hours to cool, on hooks, placed in rows on each side of the beams, just over a man's head. Here are space and hooks enough for two thousand hogs, or a full day's work of killing. The next day, or when cool, they are taken by teams to the packing-house, when the weighing, cutting, sorting, and packing, are all accomplished in the same rapid and systematic manner."*

The above will afford a good idea of the scale on which business is transacted in the United States.† The numbers packed in the two seasons 1854-5 and 1855-6 were respectively 2,473,807 and 2,124,404, the average weights being 208 and 192½ lbs. Reducing the number to pounds' weight, the following is the result:—

	1854-55.	1855-56.
In Ohio, Kentucky, Indiana, and Tennessee	391,926,200	273,502,845
Other states	122,625,656	135,444,925
	514,551,856	408,947,770

These hogs are turned into the woods in large droves, in the summer season, where they live chiefly on young pigeons, which fall from the nests. Millions of these birds build their nests in the pine and beech forests of the above states, and the high winds shake

* "Year-Book," p. 13.

† A Cincinnati merchant called on a friend of the writer's in London to offer him some pork. "I have just imported a *sample lot* of fifteen hundred barrels," he said, "which can be delivered at once, and if approved, we can ship you any quantity."

out the young birds, which are devoured by the swine. Towards winter they are driven home, and their fattening is completed with Indian corn, on which they thrive very fast; but the meat is not solid, like that which has been fattened on barley or peas, being liable to waste away when boiled. The average production of lard in the United States is estimated at 96,000,000 lbs., of which 20,000,000 lbs. are shipped from Cincinnati. Upwards of 8,000,000 lbs. are exported to England, and the same quantity to Cuba.

The deterioration of the soil in the eastern states has given a bias to both migration and emigration towards the western, which are fast becoming occupied and cultivated. The prairies of these states consist of undulating or "rolling" plains, possessing a deep rich vegetable soil over an argillaceous subsoil. In its virgin state it requires little tillage, and must be planted with potatoes or Indian corn for two or three seasons before wheat can be grown to advantage, on account of the loose texture of the soil. The great mart for the produce of these states is Chicago, situated at the head of Lake Michigan, and in the state of that name. This remarkable city, which in 1825 was a mere village, not worthy of a place in a map or a directory, had, in 1850, a population of 29,000, which, in five years, had increased to 104,000, and has probably now reached 130,000. The shipments of grain from this port in 1857 amounted to 2,200,000 qrs., of which 1,310,000 qrs. were wheat; and it will probably be double that quantity the present year (1861), so wonderfully has the production increased in the western states. Besides the navigation of the lakes, and Erie Canal, this city is the starting-point of nine grand trunk railroads, with upwards of twenty branch roads, running in different directions, and connecting the trunk roads with every part of the country. Another of these rapidly rising cities, starting up as if by magic in the west, is Milwaukee, in Wisconsin. Situated on the Upper Mississippi, it will command the grain trade of its parent state, and probably of those adjoining, for transit by way of that river. In 1840 the population of Milwaukee was 1,750; in 1850 it amounted to 20,000; and by the census table of 1860 it had reached 46,000, and is stated to have increased greatly during the past year. The receipts of wheat in 1860 amounted, in all, to 9,108,458 bushels, of which 8,582,658 bushels were shipped or sent by railway. The number of acres sown with wheat in Wisconsin in 1860 was 1,062,097, and the average yield was estimated, upon good authority, at twenty-eight bushels per acre. This will give an aggregate produce of 29,738,716 bushels of wheat. Of this it was estimated that at least 23,000,000 bushels would be exported. The lands of Missouri, Mississippi, Indiana, Illinois, &c., were equally productive of wheat in 1860; and so heavy was the crop, that hands could not be procured to harvest it, and some hundreds of acres remained uncut through the winter, and were of course destroyed.

The scarcity of hands throughout the agricultural districts of the United States has led to the employment of machinery in every operation in which it could be used to advantage. "Necessity is the mother of invention;" and a certain demand is sure to be met by an adequate supply. The whole number of patents for agricultural machines and implements, up to the commencement of 1855, was as follows:—

Grain and grass harvesters	111
Ploughs	372
Straw cutters	153
Smut machines	140
Winnowing machines	163
Threshing machines	378
	1,317

We are indebted to Americans for some of our best agricultural machines, especially mowers and reapers, although they have undergone modifications and improvements under the practical hands of British machinists. The best machines, however, require hands to work them, and these are not always to be obtained in the more thinly populated states, where they are most required, and where the use of a machine would be of the greatest importance. In the year 1855 upwards of 15,000 reaping and mowing machines were sold in the United States; and in 1860 one machinist (McCormick) sold upwards of 7,000. The introduction of machinery in every department of husbandry where it can be used to advantage is strongly insisted on by the different agricultural societies. "Substitute it," says a report of one of the county societies of Massachusetts, "for human muscles as far as possible. Save the expenditure of exhausting labour and hot sweat wherever you can. In the doctrine of eternal hard work your committee do not believe. It has come almost to this; we must cultivate our fields by machinery, or not at all. Help is scarce and high, and, what is worse, is good for little or nothing when we get it. Irish help is next door to no help at all. The chief problem is, not how much they cost, but how much they *waste!* Hence, if we must have them (and who has any other?), let us have as little as we can. As fast as may be, let us introduce horse-rakes, and corn planters, and mowing machines to our farms, and hold them as neighbourhood property. Let us domesticate among our farming tools a horse-power, a circular saw, a threshing machine, and so on, and thus diminish the necessity for hand-help, instead of importing muscle from Ireland by the ship-load. If Irishmen will come and demand their dollar a-day and board, and cod-fish on Fridays, let them pass along to those who can afford to pay them and put up with their heedless waste; . . . . let us avail ourselves of all the helps which science and modern improvements suggest for our aid."*

Most of the states can boast of agricultural societies, and some of them are very efficient. Massachusetts, however, takes the lead in these institutions, having twenty county associations, besides the "State Board of Agriculture," which superintends the whole. It has a State Farm as a model, and for the purpose both of education and experiments in husbandry. The latter object, however, is subordinate to that of instructing the youths of the State Reform School, of whom there are about 600, sent there by the courts for various offences. The number employed at a time varies, but it seldom exceeds 150, and is sometimes as low as eight or ten. A small remuneration is paid them, rather as an encouragement of good conduct than as wages. Most of the local associations have a town, or model farm, under the management of committees: these belong to the parishes, and the Board of Agriculture recommends the authorities to devote them to experiments in husbandry for the benefit of the community. The influence of these associations is beginning to be felt much more extensively than formerly, and the exhibitions are well attended. The competition for the cattle prizes is daily increasing, and the improvement in the breeds of all kinds of animals is a proof both of the interest taken in the subject and of its general utility. While, however, the virgin land in the west is so abundant, and so easy of acquisition, the migratory spirit will still continue to rule; and the ease with which good crops are raised with little trouble or expense, is a powerful motive for the

* "Year-Book," &c., p. 11

farmers to abandon the old cultivated lands, which will require so much labour and expense to keep them in a profitable state.

Nor will the exhausting system cease whilst labour is so difficult to be obtained, and so dearly paid for. The desire of immediate profit, regardless of the consequences, will always predominate over more economic motives, and private advantage over the public good; and thus, whilst the enlightened few adopt a more generous system of husbandry, and are satisfied to wait for the advantages that will inevitably accrue to them, as well as to posterity, by sustaining the fertility of the soil, the majority will continue to scourge the land by incessant cropping with cereals without manure, and with as little labour and outlay of money as is consistent with the most moderate return that can be expected from such a course of treatment.

It would be a great omission, in treating on the agriculture of the American States, if we were to neglect referring to the condition of California and its agricultural capabilities. This fine country, which now ranks amongst the States of the Union, was scarcely ever heard spoken of previous to the year 1848. The Spaniards had held it for three hundred years without attempting to develop its resources, or even to ascertain them; and, so far as the rest of the world was concerned, and even Spain itself, California was worthless in all national and cosmopolitan respects. In that year, the country was transferred by purchase and sale to the United States' government, and from that hour it has not ceased to progress in a career of prosperity with all the energy that a free people could command. The discovery of the gold-fields is a fact too well known to require any account here, if indeed it was not irrelevant to our purpose. But that a state not more than thirteen years old, and whose labour has been absorbed in an enterprise which might have been considered hostile to the more sober pursuits of business, should be able, not only to supply its own population with the necessaries of life (a large proportion of whom are constantly engaged in an unproductive employment, so far as providing themselves with food), but to export largely of wheat and other grain, is one of the greatest marvels of modern colonisation. Cargo after cargo of wheat from California has been received in the United Kingdom, the weight and quality of which is far superior to any grown with us; and such is the fertility of the soil, that it is very probable the quantity brought from thence will increase annually.

Nothing is known of the character of the husbandry practised, but the probability is, that it is of a kind similar to that of the older states; and that a present profit will lead the Californian farmers to pursue the scourging or exhausting system whilst the fertility of the soil continues to yield a profit. Other grain, as well as wheat, is also cultivated with similar success; but it is said that the most profitable kind of husbandry is the breeding and rearing of sheep. The climate of California appears to be peculiarly adapted to these animals, which breed there twice a-year, having always two, and sometimes three, lambs at a time. It is perfectly marvellous to hear of the rapidity with which a flock of sheep is raised there. The fleece is of good quality, and possesses a long staple, and if improved by crossing with the Merino, will vie with the Australian wool in the European markets.

PART III.—AGRICULTURE IN CONNECTION WITH PHYSICAL SCIENCE.

SECTION I.

THE SUBJECT CONSIDERED.

Science may be divided into two parts, namely, theory and practice. Theoretic science is a knowledge of the principles of nature. Practical science is the application of those principles in developing the resources of nature.

It is true no man can fully understand agriculture by theory alone, any more than he can any other art, because it requires a different kind of knowledge derived from experience. A man, for example, may learn the theory of weaving by studying a treatise on it; but he would soon find upon trial that the art of weaving required an apprenticeship in order to produce a material of cloth fit for use. But, on the other hand, the man who has studied his art, and thereby united theory with practice, is better prepared to execute it than another who has only followed the routine of practice, and knows nothing of the principles on which the art is founded.

The simple definition of science given above holds good in the prosecution of every department of business and all the affairs of social life; for, whether we understand it or not, science enters into, and constitutes the basis of them all, suggesting the adaptation of the best means for the attainment of the proposed end. Nor is there any employment so exalted as to be above, or so humble as to be below, the application of science in its prosecution. Take, for example, the business of a shoemaker; which man would a person prefer to employ, the one who has studied the construction of the foot—the undulating curve of the sole, the play of the joints and muscles, the slope of the instep, &c., so as to adapt the shoe to every inflection of the sinews, and movement of the numerous bones of which the foot is composed; or the man who knows nothing of all this, and forms the shoe on the old principle, with reference only to the length, breadth, and circumference of the foot? Now, the first is science united to practice; the second practice only, or with the lowest and most ignorant application of science. Ten to one the result will be, that whilst the first will produce a shoe that adapts itself to every part and every movement of the foot, the second will probably cripple you with corns, or cramp you to lameness; rendering every movement painful, and walking a penance.*

If we apply this reasoning to agriculture, we shall find that the knowledge and application of science lies at the foundation of perfect success in all its operations, from the

* We see the illustration of this fact daily in the number of persons who go limping through life with corns occasioned by wearing shoes not adapted to the foot. A slight deviation from the form of the foot in certain parts is quite sufficient to produce lameness from corns.

commencement to the end of the season. The man of science, for example, ploughs up his stubbles immediately after harvest, because he knows that the action of the frost and snow upon the soil ameliorates and disintegrates its components, renders them more immediately assimilable by the plants intended for it, and increases its fertility by attracting to it a larger portion of the atmospheric elements that promote it. The merely practical man too frequently neglects this operation, or if he performs it, it is because experience has taught him that a better seed-bed can be obtained by it than if he delayed it till the spring. Of the chemical and mechanical effect of the frost and snow upon the loosened soil, he knows nothing, and therefore cannot appreciate it.

And thus it is with all other operations of rural economy, as well as of other arts. "Every department of agriculture, and of manufacture," says Sir R. Kane, "has its origin in scientific principles. The weaving of a woollen cloth, the rolling of an iron rail, or of a brass ornament, the construction of a clock, the preparation of soap, or of oil of vitriol, all require the discovery of a certain principle, which, worked by a certain process, or certain materials, elaborates the product. Sometimes a process with particular materials is hit upon long before the principle of its action becomes known, and the art exists, but cannot extend itself, for with any other materials the process cannot answer, whilst with any other process the materials are not suited; and, hence, although the art may arrive in that limited form to great perfection, it is impossible to transplant it to other places, or in other hands. On the other side, a scientific principle may be discovered and yet remain long barren of practical results. Science and art, which should distribute, by progressing hand in hand, the highest blessings of industry and civilization, are hence often separated, and the more so that the persons by whom each is cultivated, are kept asunder by the false ideas as to what really constitutes education. The man of science, occupying himself with the interesting paths of abstract discovery, thinks not of community of objects, or of feeling, with the dark, coarse-handed operatives, who in the furnace or the forge work out the really practicable solution of his problems; whilst the worker, equally ignorant of the importance of bringing together their respective modes of experiment and inquiry, considers science, like the dead languages, as characterising the position of the upper classes, from whom, intellectually as well as socially, he keeps apart." *

Numerous examples in proof of the truth of the above remarks could be adduced; we shall give only two or three well-known ones by way of illustration. The principle of the corn-drill was discovered about the year 1670, but it was not until a century afterwards that it began to be generally used by the farmers of England. Again, the existence of sugar in all the European plants was discovered by Margraaf in 1747, and lay dormant for fifty years before a practical application of it was made in the manufacture of that condiment. Lastly, the possibility of conveying messages from place to place by electricity was discovered by a Frenchman about the year 1789,† but fifty years passed before it was deemed practicable to apply it to that purpose upon an extended scale. In all these, and many other cases, the distance between the man of science and the man of practice was too great to admit of immediate co-operation; and it required a combination of events, or an accidental concurrence of circumstances, to bring the two parties into such juxtaposition as to facilitate the practical application of the principles involved to the purpose for which they were adapted. When Paxton got into the railway carriage

* "Industrial Resources of Ireland," p. 397. † See "Arthur Young's Journey in France."

with the plan of the Crystal Palace in his hand, it was the circumstance of his meeting with Stephenson *at that moment* that facilitated the adoption of it; and it is probable that had not the latter gentleman been at the meeting of the committee to recommend it, the plan would have been thought too wild and extravagant to be sanctioned by them, and the one concocted by the council would have superseded it.

The employment of machinery in agriculture is effecting that which has hitherto been considered almost an impossibility—the union of theoretic with practical science in the operations of husbandry. Necessity is compelling the farmer to direct his attention to the study of science, in order not only to keep pace with the progress of the age, but absolutely to enable him to make head against the competition to which the legislation of the times has subjected him. That competition, however, far from injuring, has positively, as well as indirectly, benefited him, by rousing him to energetic action, and by extending the markets for his produce. Throwing off the stolid ignorance which led him—using his own phrase—to "let well alone," and adhere to the routine of his forefathers, he has made himself acquainted with the principles on which his business should be conducted, and which involve a knowledge of the laws of animal and vegetable life. On the other hand, the cheapening of the necessaries of life, and the throwing open of the ports of the United Kingdom to all comers, have by extending the markets for our manufactures, greatly increased the home consumption of agricultural produce amongst the mass of operatives who are engaged in their production.

But it is not the master alone that is benefited by the union of theoretic with practical science in agriculture; the labouring class, in their proportion, partake equally of the advantages arising from it both physically and morally. "The constant aim and effect of scientific improvements in manufactures," says Dr. Ure, "are philanthropic, as they tend to relieve the workman either from the niceties of adjustment, which exhaust his mind and fatigue his eyes, or from painful repetition of efforts which distort or wear out his frame."* If this is true, as applied to manufactures, how much more so is it the case in regard to agriculture? Take, for instance, the employment of the tasker; what possible work can be more exhausting to the frame than that of threshing corn with the flail, by the constant strain upon every muscle and sinew of the body, every joint or hinge of his limbs? A man who has from his youth been a tasker, is old at fifty, and decrepid at sixty; and if after that age he pursues the same calling, every stroke of the flail is effected with pain and difficulty, and his life is one continued penance. Equally injurious is the operation of mowing and reaping, although not so continuous as that of threshing; but, for the time, the stress upon the physical powers is enormous, and frequently produces illness with the harvest men. Many other of the operations of husbandry are more or less injurious to the labourer's health, and he is the last person who ought to complain of the employment of the machinery which tends to render his life more easy and prolonged, by divesting it of its most onerous and exhausting labour.

But the introduction of science in husbandry is equally beneficial in a moral point of view to the labouring class by creating the necessity for his being better educated. The use of machinery requires the aid of intelligent workmen, who have had a superior training to that of the peasantry in general. The farmer who employs any of these complicated inventions has found it necessary to add to his staff of men a machinist who understands their construction and use. By and by, he reflects that he has men on the farm of equal

* Ure's "Philosophy of Manufactures," p. 8.

capacity with his engineer, and for whom he must find employment. He therefore will see the policy of fitting the men already under his hands for the task, instead of employing a stranger at high wages for working his machinery.

It is well known that the class of artisans and manufacturing operatives, especially those employed in the construction of machinery, are as far superior to those of the last century as are the agriculturists. This is the effect of science applied to the arts, and the use of machinery in substitution of hand-labour. Amongst these operatives you will frequently meet with men of first-rate, though unassuming, intelligence, who would put to shame many so-called educated men, who despise them as low and vulgar. Why the rural peasantry should be the only class that continues below par in point of educational advantages, it is not easy to perceive. At any rate the period has arrived when a moral and intellectual training for them has become a matter of prudence, if not of necessity; and the sooner the landed interest sets about the task, the better it will be for them.*

SECTION II.

AGRICULTURAL PHYSIOLOGY.

The term physiology is derived from two Greek words signifying respectively *nature* and *discourse,* or argument. It therefore implies the science or study of nature, or natural physiology. It takes cognisance of all the phenomena of the three great kingdoms into which everything in nature is divided, namely, the animal, the vegetable, and the mineral; explaining their various and separate properties, powers, and functions, their analogies and affinities, their mutual dependence on each other, their distinguishing characteristics, &c.

It has been observed that "the vegetable kingdom is placed by nature intermediate between the mineral kingdom,—which is submitted solely to the operation of physical laws, and actuated only by means of mechanical force,—and the animal kingdom, in which vital organization is most complex and most perfect, and where physical and chemical affinities are subordinate in energy to the refined influence of nervous power. Everything in nature is referable to one or other of these three kingdoms or divisions, of which the first, the mineral, is distinguished by an absolute fixity of constitution, whilst the materials of which the animal is composed are in a constant state of change. If we consider a piece of marble, it contains carbon, oxygen, and calcium; and as long as it has been a piece of marble the same portion of these elements have formed it. But if we consider an animal, it is composed of numerous elements which have little permanence of arrangement. By the very act of its living force the materials of which it consists die and are thrown off from the remainder, and other new elements of the

* It is proper here to observe that it is not the design of this work to go deeply into the scientific questions on which it may be considered necessary to touch, and which would each require a volume. The object, therefore, the writer has in view, while pointing out the advantages to the agriculturists of a course of study embracing theoretic science, is to confine his remarks to such a statement of the leading principles, as may stimulate his readers to further research. Such a course, while it would be certain to open to them fresh sources of success in their business, would at the same time if steadily followed up, furnish them with a never-failing fund of the highest intellectual enjoyment.

same kind must be taken in their place, or else the whole animal dies. The living being therefore requires food to supply this want of new materials; for this food it must look abroad in nature, *it must prey*. The more highly organized animals (carnivorous) prey on those of an inferior vital power (herbivorous); these again on the vegetable kingdom. Thus, ultimately, the different kinds of plants must supply the means of sustenance to all animals' bodies; for in no case is an animal able to assimilate to its organism or use, as nutritious food, a mineral material."*

The affinity or agreement existing between the animal and the vegetable kingdoms was observed by the ancients centuries before the Christian era, and they justly considered them, to a certain extent, to possess a common nature; but chemistry had not then, nor until recent times, enabled the naturalist to discover by analysis, that the materials or elements of which they are composed are identically the same, and that both are analogous to what are found in the mineral kingdom. The latter, however, contains between sixty and seventy, whilst the two former have only eighteen, which are as follows:—

1st. *Organic.*—Carbon, hydrogen, oxygen, and nitrogen.

2nd. *Pseudo-organic.*—Sulphur and phosphorus.

3rd. *Inorganic: non-metallic group.*—Chlorine, iodine, bromine, silicon.

,, *metallic group.*—Potassium, sodium, calcium, magnesium, iron, aluminium, manganese, and copper.

Although all these are found in plants and animals, and are considered essential to their healthy existence, they are distributed in very unequal proportions, the first four, or organic, constituting by far the largest portion of both. They are deposited in the cellular fabric of plants which occupy their substance. Of the four, carbon and oxygen contribute the greatest amount, as the following table will show:—

100 PARTS OF THE FOLLOWING SUBSTANCES CONSIST OF:—

	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ashes.	Totals.
Wheat . . .	46·1	5·8	43·4	2·3	2·4	100
Wheat straw .	48·4	5·3	38·9	0·4	7·0	100
Oats	50·7	6·4	36·7	2·2	4·0	100
Oat straw . .	50·1	5·4	39·0	0·4	5·1	100
Potatoes . . .	44·0	5·8	44·7	1·5	4·0	100
Turnips . . .	42·9	5·5	42·3	1·7	7·6	100
Clover hay . .	47·4	5·0	37·8	2·1	7·7	100

Sibson also gives the following as the composition of the several kinds of produce named:—

	Wheat.		Turnips.		Cabbage.
	Grain.	Straw.	White.	Swede.	
Water	12·26	14·23	90·43	89·46	86·28
Organic combustible matter—carbon, oxygen, hydrogen, nitrogen . .	85·99	78·30	8·95	9·52	11·85
Ash or mineral matter	1·75	7·47	·62	1·02	1·87
	100·00	100·00	100·00	100·00	100·00

The organic elements are called "combustible" because they are dissipated by fire; the inorganic are termed "incombustible" because they remain in the form of an ash after being subjected to the flames, and thereby separated from the organic constituents.

* "Industrial Resources of Ireland," by R. Kane, p. 246.

ELEMENTS CONTAINED IN 100 PARTS OF THE ASHES OF THE ABOVE SUBSTANCES.

	Wheat.	Wheat straw.	Oats.	Oat straw.	Potatoes.	Turnips.	Clover hay.
Phosphoric acid .	47·0	3·1	14·9	3·0	11·3	6·1	6·3
Sulphuric acid .	1·0	1·0	1·0	4·1	7·1	10·9	2·5
Carbonic acid . .	0·0	0·0	1·7	3·2	13·4	14·0	25·0
Chlorine . . .	traces	0·6	0·5	4·7	2·7	2·9	2·6
Lime	2·9	8·5	3·7	8·3	1·8	10·9	24·6
Magnesia . . .	15·9	5·0	7·7	2·8	5·4	4·3	6·3
Potash	29·5	9·2	12·9	24·5	51·5	33·7	26·6
Soda	traces	0·3	0·0	4·4	traces	4·1	0·5
Silica	1·3	67·6	53·3	40·0	5·6	6·4	5·3
Alumina, &c. . .	0·0	1·0	1·3	2·1	0·5	1·2	0·3
Moisture & loss .	2·4	3·7	3·0	2·9	0·7	5·5	0·0
	100·0	100·0	100·0	100·0	100·0	100·0	100·0 *

The foregoing elements are all derived from the earth or the atmosphere, and are common to the whole vegetable kingdom in a greater or less proportion, and through that to the animal kingdom. Thus the highest order of organic beings, as well as the lowest, derive their origin and support their existence from the earth, to which they have an affinity by the similarity of their composition. The elements in both obey the same laws, whether in the condition of organized bodies or that of inert matter. The complex nature of these substances renders it necessary that the soil should possess a corresponding complexity of composition in order to supply those elements essential to the healthy growth of the plants. All soils do not possess them, and those which contain the largest proportion will become exhausted of them by repeated cropping, because every crop removes a certain quantity and lessens the productive power. A knowledge of this lies at the foundation of good husbandry, and it is therefore desirable that the agriculturist should well understand the composition of the soil he has to cultivate, as well as of the plants he proposes to grow upon it, that he may be able the more intelligently to adapt the three elements of production—"soil, seed, and manure"—to each other in the manner and proportions most conducive to a successful result.

Soil, in the common acceptation of the term, is the surface coating of the land, and is considered to consist of any combination of earthy particles that are capable of cultivation, being termed good or bad in proportion to its fertility. But this definition is inconclusive and erroneous, because it mixes up the *means* of fertility with the *medium*, ranking them under one category. Soil in itself, abstractedly considered, is in all cases *barren*, and only becomes fertile by the addition of certain elements which do not belong to it. It is the basis of cultivation, the medium for the reception of the elements of fertility to convey them to the plant, but it does not naturally contain them. They are purely accidental additions, and not inherent or integral parts, of the soil, because they can either be imparted to, or withdrawn from, it without divesting it of its character. In the one case it may be enriched, and in the other impoverished; but in either it remains a soil, and is the basis, but not the source, of fertility. A pure sand, for instance, is infertile in itself, and incapable of sustaining vegetable life, but by a mixture

* Boussingault. These substances are not all found in every plant, except the carbon, oxygen, hydrogen, and nitrogen, which are always present in the tissues both of plants and animals, the former deriving them exclusively from the latter, there being no evidence to prove that those elements are obtained from any other source. Before, however, the animal can receive these elements from the plant, they change their simple form into various secretions of the vegetable tissue, to which are given the names of gluten, fibrine, albumen, casein, &c. These serve to sustain the fabric of the body of the animal, otherwise exhausted by the waste produced by exertion, perspiration, &c.

of clay and of the elements of fertility it may be made the basis of a florid and healthy vegetation; and so of other descriptions of earth, which in themselves are barren, or have been rendered so by bad husbandry. They are still soils, although divested of everything that is essential to vegetable life.

Soils are formed of the detritus of rocks, on the constitution of which depends their character. If the rock from which a soil is derived is of simple structure, without any adventitious mixture of other elements than its own base, it is not fitted alone to sustain vegetable life; but there are few rocks of this simple character, and most of them contain the remains of organic substances, which constitute the elements of fertility. The more complex and varied the composition of the rock is from which a soil is derived, the better is the latter adapted to the purposes of cultivation. Tracts of land bordering on large rivers, whose course extends through countries containing rocks of different structure, and which occasionally overflow their banks, usually possess soils rich in the elements of fertility and highly favourable to a luxurious vegetation. The *débris* brought down by the stream after the winter's frost and snow, and deposited upon the lands on either side, forms a rich basis for cultivation. The Nile, the Mississippi, the Plata, the Amazon, and other great rivers, have, by the deposits of centuries, formed extensive deltas at their embouchures, which, being annually replenished with fresh fertilizing elements by overflows, never lose their productiveness. It is said that the delta of the Nile has been known to yield more than one hundredfold of the seed sown.

Linnæus has described the gradations of the functions of existence in the three kingdoms of nature, in the following propositions. "Minerals *grow;* plants *grow* and *live;* animals *grow, live,* and *feel.*" These distinctive definitions are not absolutely borne out by facts, for it is well known that certain plants of the sensitive species shrink from the touch, and that others display a sort of instinctive vital consciousness of enjoyment incompatible with the absolute want of feeling. The sunflower is careful to keep its disk towards the sun, and many other flowers exercise the same precaution. Almost any plant will direct its roots towards a spot where an extraordinary supply of proper food, or of moisture, is deposited. The great Hambro-grape vine at Hampton Court, found means to insinuate its roots into the sewer of the palace, which in process of time was stopped up by them. Le Couteur mentions a remarkable instance of repugnance evidently displayed by a particular kind of spring-wheat to a neighbour of the winter species. At blooming time, so far from showing a disposition to cohabitation, it actually turned its head *against the wind,* in the opposite direction, in evident disgust. Many such instances are recorded by naturalists, and they go far to prove that the vitality of plants is not a principle wholly destitute of the attribute of sensation. Further, when we consider the very small, yet certain, degree of feeling displayed by the lowest order of animals, and that the link which unites the two kingdoms of organic life is so equivocal in character as to render it difficult for the most acute naturalist to determine to which it belongs, may we not by induction infer that a graduated scale of sensibility accompanies the transition from the animal to the vegetable, and *vice versâ,* and that the benevolent Creator has imparted to plants, as well as to animals, a capacity of enjoyment "after their kind," and suited to their nature?

Such instances, however, as those we have referred to, while they, in a measure neutralise the aphorism of the learned botanist, by no means establish an identity or equality of existence between plants and animals. "When we regard the functions," says a modern writer, "performed by these two great kingdoms of nature, there is manifestly an antagonism between them, which is probably maintained throughout the whole series of beings of which they are composed. It is obviously a common property of the tissues of all plants to absorb carbonic acid gas from the air and water in which they live. This gas is composed of carbon and oxygen, and one of the processes of the life of plants is to appropriate the carbon and give out the oxygen. On the other hand, all animals imbibe oxygen gas, which, penetrating their tissues, combines with the carbon of their food, and forms carbonic acid gas, which they give off from their bodies. It would be difficult perhaps to apply such a test on a small scale; but there can be no doubt that these are the distinguishing features of the vegetable and animal kingdoms; and that where we find oxygen absorbed and carbonic acid given off, we have an animal, and that when carbonic acid is absorbed, and oxygen given off, we have a plant."*

In animals, the function of the eye is sight; of the ear, hearing; of the lungs, the purification of the blood by ventilation; of the stomach digestion; of the liver, to secrete bile, &c. In plants, the function of the spongioles of the radicles is to absorb from the soil the elements of nutrition; of the leaves, to decompose carbonic acid of the atmosphere, so as to appropriate the carbon for the use of the plant; of the anther, to impregnate the ovule by means of its secretion, the pollen; of the ovary, to mature the ovule into a seed, &c. The vegetative functions are called the functions of maintenance; the animal functions, relative functions, or functions of relation. The action of these functions of both plants and animals, constituting the phenomena of life, are described under the head of mechanical, chemical, electrical, &c. A great many of the most important actions of the perfect animal body are purely mechanical, or purely chemical, or partly chemical and partly mechanical. In the circulation of the blood, for instance, in man, and in animals resembling man, the blood is propelled onwards by mechanical force, while those mechanical forces are called into activity in obedience to the laws of excitability. In the functions of respiration, the air enters the lungs in conformity with the laws of that part of mechanical science called pneumatics. The change which the blood undergoes by the contact with this air, is a chemical change, or a change closely analogous to it, while these laws of pneumatics, and the chemical laws, are brought into operation by the agency of an organic excitability. The fluids contained in the leaves of plants in contact with atmospheric air, by the influence of light, also undergo a chemical change, or a change exactly analogous to a chemical change, while the leaf presents its upper surface to the light under the direction of a peculiar excitability.†

Physiologists at present define excitability rather as a negative than as a positive term, embracing all the properties of an organic tissue, whether belonging to the animal or the vegetable kingdom, that are neither mechanical nor chemical. It renders those

* Carpenter, "On Vegetable Physiology." A test has of late years been adopted for determining whether a doubtful specimen of organic life belongs to the animal or vegetable kingdom, by means of iodine. It has been generally assumed that starch is a constituent of vegetable tissues, whilst those of animals are destitute of it. If, therefore, the blue colour imparted to starch by iodine is found in the specimen, in whatever proportion, it is deemed at once a vegetable. Unfortunately for the correctness of this theory, some German physiologists have lately detected and demonstrated the existence of starch, or a substance of amylaceous character, in some of the lower, but undoubted, animals; and in the brain and spinal cord of man, a substance termed cellulose, hitherto considered peculiar to plants, has been found; so that the test fails, and the learned are at sea again.

† Orr's "Circle of the Sciences," article, Physiology.

tissues susceptible of certain phenomena, different from those produced by the same cause on inert matter. Thus, with inert matter, the form and texture of a leaf may be exactly imitated; but such an artificial leaf will have no power to turn to the light in the sunshine, or to exercise any other vital function.

It is the property of organic, or living, matter alone to reproduce its like, for no modification of any part of the mineral kingdom possesses such a faculty;—it possesses, however, that of a divisibility, which some philosophers have considered infinite, and which, if not so, has at least no known limits. Even the minutest portion also retains all the properties of the mass from which it was taken. In this respect it differs entirely from organic bodies, which are destroyed by subdivision. These latter too, whether belonging to the animal or the vegetable kingdom, pass through the periods of infancy, youth, maturity, old age, and death; after which their elements separate, in the absence of the vital energy that kept them together, and become again united with the inorganic masses from which they were derived, retaining not the smallest similarity to the organism they have separated from. The mineral, on the contrary, retains the same properties and character unchanged for ever. A lump of clay, or a grain of sand, or piece of granite, would remain the same as long as the world stands, unless mechanically acted upon by the elements of the atmosphere or by the hand of man.

The circulation of the sap in plants differs materially from that of the blood in animals. The fluids are taken up by the roots, but are not, as in animals, conveyed to a central medium for circulation throughout the system, as by the heart of an animal; but are conveyed from one cell to another by a peculiar process upon the theory of *endosmose* and *exosmose*.* Solutions of chemical substances are taken up by the roots; they interchange with the cells above them, which contain a denser fluid in what is termed sap. To this force Henfrey adds the influence of capillarity, the combined action of which with endosmose and exosmose is thus described: "The cells of the pith in the neighbourhood of the buds and other situations are filled with watery juices containing insoluble secretions, such as starch, fixed oils, &c., which are stored-up nutriment. The heat and moisture of spring produce the decomposition of these secretions, and the starch, oil, or other substances becoming converted into dextrine and sugar, the cells are filled with dense mucilage and syrup. Here there is a sufficient cause for a strong endosmotic action to be set up, since this is not subject to the same statical laws as capillarity. Development is almost simultaneous, and evaporation quickly follows: the capillary is then free to act, and the two forces are kept in vigorous action by a rapid development of structures, and, consequently, evaporation of water and liberation of oxygen, which take place."†

The fluids thus absorbed by the roots and conveyed to the cells, are transferred to the leaves through the alburnum, or layer of newly-formed wood, the cells of which are not yet filled with ligneous matter. By this it is conveyed to the leaves, and is subject to the action of *exhalation* and *respiration*, the former implying the evaporation of water containing gaseous matter, and sometimes organic compounds. Light and heat are required to facilitate its action, which ceases at night. It is much more abundant in

* These names are given to the operation of mixture through a membrane accompanied with change of volume—the former implying an increase by a strong in-going current; the latter, a decrease or diminution by a weak out-going current.

† Henfrey's "Structural Physiological Botany."

some plants than in others, because their action is slower. This is the case with fleshy-leafed plants, which endure drought better than thin-leafed ones. Whilst a constant current is sustained by exhalation through the permeable tissues of plants, it disposes of the excess of water required for the solution of the chemical matters constituting the food of plants, and which can only be assimilated by them in a soluble state.

By *respiration*, oxygen is inhaled by animals, and after being divested of its carbon, is absorbed. The carbon being exhaled in the form of carbonic acid, is taken up and fixed by the plant, forming part of its structure. Respiration in plants is considered by some equivalent to digestion in animals, consisting in the decomposition of some substances, and the fixation of others, by assimilation. But it is rather analogous to the corresponding operation in the animal respiration and exhalation, which are entirely distinct from the process of digestion. Neither have plants the digestive organism at all analogous to those of animals, such as the stomach, of capacity to receive food, the gastric juice to dissolve it, &c. Plants receive their food both by their roots and leaves,—not in the crude state in which animals take sustenance, but prepared ready for assimilation by the atmosphere; and the liberation of the oxygen, and absorption of the carbon is rather analogous to the contrary result in the respiration and exhalation of animals than digestion.*

The liquefied and gaseous form in which plants receive their food requires a totally different set of organs from those of animals, which receive their sustenance in a gross and crude state. Both, it is true, are submitted to the action of chemical agencies to fit their food for assimilation to promote the full development of their parts, and for the sustainment of their existence. But in the case of plants, the food is of necessity chemically prepared before it is absorbed, and the changes it subsequently undergoes, in order to a more perfect assimilation, have no analogy whatever to the digestive action of the animal, which, operating upon crude and solid materials, requires the addition of liquids in the stomach in order to reduce the whole mass to a semi-liquefied state. The chemical change, analogous to that which then takes place in the stomach of the animal, is effected, in the case of the plant, in the soil, where it is necessary that the earthy matters constituting their food should be dissolved, in order to fit them for assimilation. In the stomach of the animal, the nutritive portion is taken up by the absorbent vessels, whilst the unappropriated portion is ejected in a solid fœcal form.

The life and proper growth of the animal depend upon the continuance of the mechanical and chemical changes we refer to. The stomach is the animal laboratory, and receives the gross aliment, which in the process of mastication becomes mixed with the salival juices; these are an essential ingredient in producing the changes that are about to take place. The stomach secretes a liquid, called the gastric (or stomachic) juice, the function of which is to dissolve by chemical action, whatever elements of nutrition are submitted to its influence. A mechanical action of the stomach is at the same time produced by that of the lungs in breathing; this action has nothing chemical in its nature, nor has it anything whatever to do with digestion,† further than

* One class of animals only is at present known that deviates from the ordinary conformation, in having no stomach or digestive organs. The *Entozoa*, which live in the intestinal canal or in the substance of the tissues of other animals, are supported on the nutrient juices of their bodies; and these being already prepared for their use, are immediately assimilated without the necessity of further digestion.

† This has perfectly been demonstrated by the experiments of Spallanzani upon animals and upon himself. He enclosed aliments of chickens' flesh and veal in small hollow balls of perforated tin, about the size of a hazel-nut. These

more intimately mixing the various matters contained in the stomach after they have been acted upon and dissolved by the gastric juice, and thus preparing the nutritive portions for assimilation by the tissues of the stomach. This, however, is a most important function of that organ, and its obstruction to any extent is injurious to the absorptive powers, which are materially assisted by the alternate expansion and contraction of the stomach, occasioned by that of the lungs in respiration.

It was once generally supposed that plants possessed an organism corresponding in every particular with that of the animal kingdom, and that digestion, respiration, excretion, perspiration, &c., were common to both. But, independently of the plant having no stomach of capacity to receive a mass of crude sustenance, they have no tissues to enable them to absorb nutrition, or to distribute the juices, or to perform the functions of secretion, which are all found in the animal kingdom; nor have they any fluid analogous to the gastric juice to act as a solvent, such a fluid being rendered unnecessary by the chemical change having been effected in the sustenance of the plant in the earth or air. "In one word, the general organic functions are introduced into the two living kingdoms of nature, and probably into their subordinate divisions, by two different ways. This difference leads at once to the conclusion that the structure of the animal is not a simple repetition of that of the plant, with the addition of a series of new apparatus. The nature of the tissues, the mode of their action and change, the form, division, and destinies of the organs,—all these rather teach us that animals of any development are constructed upon an altogether different plan."*

The investigations of physiology into the structure of plants and animals have proved to a demonstration that organic beings, from the most exalted of the human race, to the humblest plant that claims the attribute of life, derive their elementary composition from the earth. We have seen that these elements of organic life have been separated, defined, compared, and identified with their inorganic congeners, by which the perfect connection between the three kingdoms of nature is as satisfactorily proved as any sum in arithmetic or problem in Euclid. But it is equally clear, that although by certain chemical combinations of inorganic elements, the chemist can change their form, and produce substances unknown to nature, and exhibiting a character totally unlike any separate element, no effort of science or art can endue such combinations with life in any form whatever. "When then, in connection with this undeniable truth, it is considered that for long periods of time our planet, the earth, must have been, from physical circumstances, totally incapable of supporting any form of organic existence,† the conclusion follows, that the appearance of organic existences on the earth implies an exercise of infinite power, by which mineral matter was endowed with the new property of passing into the first species of animal and vegetable life. It is vain to say that such statements lie without the pale of inductive science. Man's natural curiosity

he swallowed, and in twelve hours, when they were voided, he found them empty, the flesh having been digested and extruded from the balls through the perforations. The action of the stomach could therefore have had no part in the digestion of the meat, which was entirely effected by the gastric juice. But the experiments of Réaumur were still more decisive. He fastened small pieces of sponge to a thread, and gave them to swallow to birds of prey; at the end of five minutes he withdrew them from the stomach, saturated with gastric juice. He then enclosed them in that state in a glass tube, slightly warmed, and in two hours found the sponges dissolved, precisely as they would have been in the stomach of the birds.

* "Valentine's Physiology," by Brinton.

† This geological fact is proved by the second verse of the first chapter of Genesis: "And the earth was without form, and void; and darkness was upon the face of the deep." This was a condition of things totally incompatible with organic life in any form whatever that we are acquainted with.

loudly asks, whence came organic species? whenever he considers the undeniable truth, that the surface of the earth must have lain for ages destitute of such existences; and the answer, which by the original constitution of his mind he is compelled to give, is, that such a change on the mere matter of the crust of the earth as its transition into living forms, could not have occurred without the interposition of Omnipotent power."*

SECTION III.

THE GERMINATION AND CONSTITUTION OF PLANTS.

Germination is the development of the germ or embryo seed-bud into a perfect plant. This process is promoted by, and requires, heat and moisture acting chemically and mechanically upon the seed by causing it to swell, and stimulating the vital principles. There is reason also to believe that electricity has a large share in this operation, and that without it germination could not take place. In the first instance, the cotyledons or lobes of the seed furnish the young plant with nourishment until it has struck out its *radicles* or roots from the lower end of the germ. This operation is effected simultaneously with the shooting up of the *plumule* or stem. As soon as the roots are formed and have taken hold of the earth, the plant thenceforth depends on them alone for its future growth and nourishment.

The dependence of germination on heat and moisture to stimulate the vital principle is common to all plants, but they differ in the degree each requires of these elements. Some plants will only vegetate in water, whilst others love a dry soil. Tropical plants, such as the Victoria Regia, generally require a temperature of 70°, whilst the common English water-lily germinates at 55°. The natural heat of the earth, even in winter, is sufficient to keep the vital principle in action in some plants—wheat, for instance—whilst in the generality of plants it is perfectly inactive and dormant during that season.

It is impossible to say what is life, what is its seat, or its principle, in plants or animals; whether it is absent in the embryo until acted upon by secondary chemical forces, or whether it is inherent in the seed independent of an auxiliary power. If we take a grain of wheat, and with a sharp knife divide the germ, and examine the parts with a powerful microscope, we find it contains all the essential parts of a plant in miniature — the root, the stem, the blade, the ear; but it possesses no vital force to stimulate their growth until it is submitted to the action of air, heat, and moisture; and yet is not its vitality proved by the fact that immediately it comes into contact with those elements it begins to exercise its functions? Another proof is, that if exposed to the elements of air and heat alone, without moisture, after a time it dies or loses its vitality, and no future combination of these elements can restore it so as to cause the seed to germinate.†

* Carpenter.

† No modification of light, air, and moisture can produce vegetation without a due proportion of heat, according to the nature of the plant or seed; but there is reason to believe that simple heat is not sufficient to stimulate vitality, and that the peculiar modification of it called electricity is essentially necessary for that purpose. At the same time, electricity

In germination the cotyledons, in some cases, appear above ground, forming leaves, and supplying the germ with its first nourishment; in other cases they remain in the ground, but in these they equally support the young plants with their substance until the roots have acquired sufficient maturity to perform the office of feeders. When a bean, for instance, is committed to the earth, it the necessary conditions of heat and moisture exist, germination immediately commences; that is to say, the seed swells and bursts its outward coating, and the cotyledons separate, and are brought by the upward movement of the plumule above the ground, where they turn green and form the first leaves of the plant. In the case of wheat, on the contrary, the cotyledons remain attached to the radicle end of the seed below the ground. In both cases it is the starch in the cotyledons that constitutes the food of the young plant until it can receive it through the medium of the roots.

There is a great difference in the period for which the vitality of seeds can be preserved. Some lose it, or feebly retain it, after the first or second year, whilst others are found to vegetate that have been preserved for centuries. Tobacco has been found to preserve its vitality ten years, stramonium twenty-five, and so on. But the most remarkable case was that of some raspberry seeds found near Maiden Castle, Dorsetshire, in an ancient coffin, with some coins of the Emperor Hadrian, and which had therefore been buried 1400 or 1500 years. These seeds vegetated when planted, and produced good plants. "I have now before me," says Dr. Lindley, "three plants of raspberries, which have been raised in the gardens of the Horticultural Society from seeds taken from the stomach of a man, whose skeleton was found thirty feet below the surface of the earth at the bottom of a barrow which was opened near Dorchester. He had been buried with some coins of the Emperor Hadrian." Most of the seeds of the brassica tribe of plants possess this enduring faculty when preserved dry, and excluded from the external air. We have known an instance in which, when a house has been taken down that had been built at least 200 years, and the ground which it covered broken up, it immediately became a mass of charlock plants (wild rape). The history of the wheat called "mummy wheat" is too well known, and too much disputed, to be quoted as an example; but we may observe that it is quite within the bounds of possibility that wheat or any other seed would retain its vitality if enveloped in cerecloths and bandages, which protected it from the external air, and in so dry a climate as that of Egypt. Seeds found hundreds of feet below the surface have been known to vegetate as soon as they were exposed to the heat and moisture of the atmosphere. It is a singular fact hitherto unaccounted for, that seeds brought from India by long sea-route will seldom germinate, but those brought by the overland passage grow freely.

Embryos are divided into *aperispermic* and *perispermic*.* The first contains within itself, especially in the cotyledons, all the nourishment it requires to assist in germi-

cannot act upon a body to restore vitality in the absence of heat, or when the fluids become coagulated and the body rigid. Thus, whilst the natural warmth is retained in a dead animal, it is quite possible by applying the galvanic current to its limbs to produce a temporary restoration of the vital functions, although no consciousness attends such restoration. A physician in the United States applied galvanism to the body of a man recently deceased, but still warm: under the operation the corpse gradually became animated, and at length rose to its feet, strode over the electrician or galvanizer, ran against the opposite wall, and again fell down a ghastly, inanimate corpse as before. It may be assumed that every living organic body is a galvanic battery, possessing an apparatus for the electric current to circulate, by which alone the vital principle is kept in existence. The interruption of this current is the cause of disease; its absence, that of death.

* "Perisperm—the testa or albumen of a seed."—*Webster ex Brandt.*

nation, and nothing but the embryo is found when the skin (or coats) of the seed is removed. A *perispermic* embryo, on the contrary, has a separate supply of nutriment, which, under the skin, is found to surround it more or less. This nutritive matter, or perisperm, consists of amylaceous, gummy, and saccharine substances, mixed with oils, resins, nitrogenous matters, and certain salts, as phosphates, sulphates, and chlorides. The quantity of these elements of nutrition is always in excess of the actual requirements of the embryo if in a healthy state, and under ordinary circumstances. In the cereal grains the pericarpial covering and the integuments of the seeds are incorporated with each other, and they are completely emptied of the starch and other matters by absorption during the germination of the embryo, the pericarp (or bran) not being itself dissoluble.

Air is found to be as essential as heat and moisture in the process of germination. This was demonstrated by Ray, Boyle, and others, previous to the discovery, by chemical analysis, of the composition of the atmosphere by Priestley. Seeds will not vegetate at all when buried deep in the ground, and thus excluded from the atmospheric air. They also germinate quicker in the shade, or in diffuse daylight, than under the direct action of the sun's rays. Experiments have proved that seeds buried at a depth just sufficient to exclude them from the light, but not from the air, germinate better than if sown deep in the soil. The depth of an inch and a half for a clay, and three inches in a sandy or gravelly soil, are the proper depths for cereal grain. The drill for this purpose is better than broadcast sowing, because the seed being all put in at one uniform depth, not only comes up more regularly, but also ripens altogether, which is not the case with broadcast sowing. The more lightly the seed is covered, the more readily it vegetates, and the stronger it afterwards throws up its stem.

Drainage is an important artificial means of promoting germination. Under ordinary circumstances the natural heat of the earth is sufficient to effect it, but the temperature is greatly increased by drawing off from the soil the stagnant or superabundant moisture, which absorbs the sun's rays without any advantage to vegetation. This is the cause that on drained soils the corn, &c., is always forwarder and better than on undrained, the temperature of the former being from 10° to 20° higher than that of the latter. This will also account for the great amelioration of the climate of England and Scotland, especially the latter country, where, during the last twenty years, so large a portion of the land has been drained. Formerly the snow usually fell in November in Scotland, and lay until April, but now it seldom appears before Christmas, and is gone in February or the beginning of March, the quantity being much less also. The temperature is neither so low in winter, nor so high in summer, nor are the storms so violent or frequent. The consequence is that agriculture in Scotland is no longer a precarious employment, more than in England; and the finest cereals and other crops are now raised in situations where formerly it would have been considered folly to attempt it.

It is not the great quantity of water that falls upon the land that produces the mischief, but its having no channel for escaping. Rainwater contains ammonia and other fertilising substances, which in passing through the soil are fixed by the salts contained in it, but if the water is allowed to remain and become stagnant, it neutralises the benefit, and by lowering or keeping low the temperature of the earth, chills the plants and checks their growth. In a wet time like that of 1860 the seed upon undrained land rots before it can germinate, the superabundant moisture having no way of escape.

Plants are composed of three parts, the roots, the stem, and the branches. The first throw out their fibres and more solid ramifications in every direction in the soil; the last two do the same in the air. The stem contains in its column all the tubes which supply the branches with nutriment, closely packed within the rind or bark like a bundle of sticks tied together. The ends of the roots are furnished with *spongioles*, or a substance similar to sponge, which absorb through their minute pores the nutriment of the plant, presented to them in a liquefied form in the soil.* The pores of the spongioles are too small to admit any solid matter however comminuted it may be. All minerals, therefore, before they can be absorbed are subjected to the chemical action of other elements, which dissolve them, adding their substance in the shape of acids and alkalies. These are equally necessary to the health of the plant, however small may be their proportion compared with that of the organic elements. Phosphoric acid, for instance, enters largely into the composition of seeds, being a necessary constituent of the bran or skin of all plants, which could not be formed without it. In animals it constitutes, combined with lime, a large proportion of the bones. The other inorganic elements found in plants, as salt, lime, potash, sand (silica), &c., are equally necessary to the perfect structure and health of the plant, and to the production of seeds possessing the germinating faculty. Many soils are destitute of one or other of these constituents, and they must be supplied to them in order to promote their fertility.

We have already stated that seeds germinate quicker in the shade than when exposed to the sun's rays; for the same reason the nurserymen and florists place cuttings, when planted, in a shady situation until the rootlets are formed, darkness having been found to promote their growth; but as soon as the seed has germinated, or the cutting has formed its roots, it must be exposed to the light and air to perfect its vegetation. Dr. Gladstone instituted a series of experiments on both, with very decided results. He found that the development of roots requires the absence of the chemical ray, but was favoured rather than otherwise by heat and luminosity. The plumule also was developed quicker under similar circumstances; but it was found that those conditions did not produce a healthy plant, the growth being too rapid and succulent; and that, although cutting off the chemical ray facilitated the process of germination in the protrusion of the radicles and the evolution of the plumule, obscurity caused an unnaturally tall growth and poor development of the leaves, whilst it prevented the formation of *chlorophyl*, or the colouring matter of the leaves.

"During the germination of seeds alterations take place in the nature of their contents. When the embryo occupies the entire seed, changes occur in the cotyledons, by means of which nutritive matter is prepared. When there is a separate store of perisperm, its constituents are acted upon by moisture, heat, and air, so as to undergo chemical changes. Alterations take place in the azotized matters, and part of the fibrine gives origin to diatose, which acts as a ferment. Acetic acid is formed, which converts the starchy matter into grape sugar and dextrine. These insoluble matters are

* An opinion now prevails amongst some naturalists that the spongioles are capable of taking up and assimilating solids as well as liquids, and that the mineral matters found in plants did not require, nor pass through, the liquescent process, generally considered indispensable before it could be absorbed by the roots, or assimilated by the cells and vessels. If this, however, is a correct theory, plants must necessarily have digestive organs, but we are not aware that these have been discovered. The exceeding minuteness of the mouths or orifices of the roots is against the opinion, and it is more reasonable to conclude that the spongioles have a liquescent power, by chemical means, to reduce the solids before they are absorbed.

rendered soluble, and a large amount of saccharine matter is produced. At the same time there is an evolution of carbonic acid, in consequence of a combination between the oxygen of the air and the carbon of the seed; and, as the result of this chemical action, a certain amount of heat is evolved. This heat is carried off rapidly by the soil in ordinary cases, so that it is difficult to ascertain its amount; but when seeds are laid in moist heaps (as in malting barley) the increase of temperature becomes apparent."*

Starch is a constituent of all plants, being found in a greater or lesser proportion in the cells. It is detected by its turning blue with iodine. Its composition is, carbon, 12; hydrogen, 10; and oxygen, 10. It supplies nutriment to the plant in the form of sugar, into which it is converted by the acetic acid formed as stated above, with the addition of a due proportion of heat. Starch contains no nitrogen, and is therefore destitute of flesh-forming properties. Plants have, in fact, no power to assimilate nitrogen in its simple form, but only in that of ammonia. It is this latter substance, therefore, that is essential to the growth and health of plants; and as it enters largely into the composition of gluten, which is a flesh-forming substance, so it adds to the value of plants in proportion to its volume. Starch alone possesses no nutritive property, and animal life could not long be sustained upon it. A child or a dog fed upon it would soon die of inanition.

Albumen is found in the white of eggs, in the blood and flesh of animals, and in oily seeds. When mixed with an acid it coagulates, and metallic salts have the same effect upon it. White of egg is therefore given in cases of poisoning with copperas or arsenic. *Fibrine* is soluble in the blood during life, but after death, or separation from the vessels, it spontaneously separates, and coagulates into a fibrous substance insoluble in water. It is found also in the muscular fibre, from which it derives its name. *Caseine* is the curd of milk; it takes its name from the Latin word *caseus*, cheese, of which it forms the chief material. *Legumine* is a constituent of most plants, but is found in greatest quantity in peas and beans in their several varieties. All these are flesh-forming substances, and stamp a proportionate value upon those plants which possess the largest quantity of them.

Gluten, or vegetable fibrine, is formed largely in wheat, from which it is easily separated. Professor Playfair, in one of his lectures, observes, "If water is poured on fine flour in a sieve and stirred about, a milky fluid will percolate into the basin below; on adding more water, the liquid will after a time pass through quite clear. On the sieve will be seen a glue-like substance called *gluten*, while at the bottom of the basin will be found white granulated particles called *starch*. . . . . This gluten we have on the sieve is one and the same thing as the muscle of my arm, as dried blood, or the flesh of the ox; so we eat the flesh ready formed in our food. This is a very wise arrangement of nature. The vitality of plants is not required to execute the commands of the will, and therefore its whole powers are employed in creating new compounds; but in animals the vital principle has many duties to perform assigned to it by the will; the powers are therefore husbanded to this end. All that the vitality in the animal economy has to perform connected with nutrition is to assign a place and form to the food, which is already of the proper composition." Starch and gluten constitute the greater part of wheat, but it is the latter that gives strength to the flour made from it, and imparts to it its nutritive power. On the proportion of it that is contained in flour, depends the quantity of bread that a given quantity of flour will produce. The proportion of gluten varies

* Carpenter.

materially in wheat. Boussingault instituted a series of experiments with different kinds of manure, in the cultivation of wheat, in order to ascertain their comparative value in the production of gluten. The following table shows the results:—

Manures.	Gluten.	Starch.	Bran and soluble matters.	
1. Human urine	35·1	39·3	25·6	100
2. Bullock's blood	34·2	41·3	25·5	100
3. Nightsoil	33·1	41·4	25·5	100
4. Sheep's dung	32·9	42·8	24·3	100
5. Goat's do.	32·9	42·4	24·7	100
6. Horse do.	13·7	61·6	24·7	100
7. Pigeon's do.	12·2	63·2	24·6	100
8. Cow's do.	12·0	62·3	25·7	100
9. No manure	9·2	66·7	24·1	100

These experiments, executed by one of the first chemists of the age, have a remarkable significance and value, as throwing light upon the properties of different manures in the production of the most valuable quality of wheat; and also as illustrating the characteristic of wheat in varying its composition according to the manure applied to it in cultivation, the seed and the soil being in every respect the same. Number 1 with its 35·1 per cent. of gluten would produce flour worth many shillings per sack more than number 9 with its 9·2 only of gluten. To illustrate this we may state that a few years ago some flour was imported from St. Petersburg, which, to the astonishment of the bakers who used it, produced 108 four-pound loaves, or 432 lbs. of bread from the sack of flour of 280 lbs.!* Nothing like this had ever been seen before, or since, in the London flour trade; and it is to this day a mystery to the London millers how such flour could be produced from Russian wheat, which can only be sparingly used by them on account of its hardness and dark colour. This flour, sold at 5*s.* per sack above the highest price of town-made flour, upon analysation was found to contain about 32 per cent. of gluten and 68 per cent. of starch and other matters.

It will be seen on looking over the above table that the proportion of starch increases as that of gluten diminishes, and *vice versâ*, whilst the variation in the amount of other materials is very trifling in all of them, not being more than 1·6 between the highest and the lowest in the scale. Wheat, therefore, which is the least valuable to the miller or the baker is the most so to the starch-maker. Thus taking weight for weight number 9 will produce for the latter 27·6 per cent. more starch than number 1; while, on the contrary, the baker would probably obtain six or eight more four-pound loaves from number 1 than from number 9, if the flour were properly manufactured. Talavera wheat contains more gluten than any other species grown in England, and is therefore much sought after by the millers. The writer had once a parcel of Talavera flour consigned to him by a miller in Norfolk. The wheat had somewhat sprouted when on the shock in the field, but was carefully manufactured, and when worked up by the bakers was found invariably to produce 102 loaves of four pounds each to the sack. The Talavera wheat was introduced into England during the Peninsular war. Being liable to sprout at harvest from a slight rain, it is not a favourite with farmers.

Whilst the constituents which enter into the composition of plants are the same in character in all vegetable substances, we find that their proportions vary materially, even in those of the same species, so as to alter their relative value as articles of food.

* The number of loaves produced from a sack of London household flour is about ninety-four.

These variations must be ascribed to local causes in the soil, or to accidental ones in the manure employed in their production. The subject, however, is involved in some degree of obscurity even amongst scientific men. "We have known," says Gay Lussac, "for a long time that vegetable substances are formed of hydrogen, oxygen, and carbon, and that animal substances contain, besides, azote; but we do not yet know what is the quantity which each contains. It is to this cause that we must attribute in great part the little progress that animal and vegetable chemistry has at present made. In fact, it does not suffice to know the principles which constitute a body in order to understand all the phenomena that may result from itscont act with others. For that purpose we must still know the relation in which they stand with each other. This truth was too striking not to have been perceived. Besides, we see that the chemists have treated animal and vegetable substances sometimes by nitric acid, and sometimes by fire, in the hope of being able to arrive at the knowledge of the proportions of their principles. Unfortunately, these two methods of analysis can only conduct to very inexact results. When we employ nitric acid we partly convert these substances into prussic, malic, oxalic, and acetic acids, and we transform the nitric acid into very variable gases, which it is necessary to collect and separate, in order to calculate the results of the operation, which it is still impossible to do with precision."

Agricultural chemistry has made great advances since the above was written, but there are still mysteries connected with animal and vegetable life which the most acute physiologists have not had, and probably never will have, it in their power to unravel. We know now, for instance, that the blood of an animal and the sap of a plant circulate throughout their several systems (although in a different manner), but we are ignorant of the nature of the power by which the former is kept, during the life of the animal, in perpetual motion; or the latter is made to rise in the vessels and tissues of the plant as by the action of a forcing pump or a hydraulic machine. Life itself, as we have already observed, is the greatest mystery of all, and baffles the mental powers of man to discover in what it essentially consists. The seat of the soul in man, and the connection between it and the body, and many other of the phenomena of life have occupied vainly, so far at least as the immediate object of research is concerned, the attention of philosophers in all ages of the world, from that of Pythagoras to the present day, and new systems have continually been started to the exclusion of the old, to be themselves exploded by still more novel hypotheses. One benefit mankind has derived from these researches—the discovery of collateral truths of more practical value than the real object of investigation; so that we find ourselves drawing nearer and nearer to the *arcanum* of nature, although the hope of arriving at its innermost sanctuary may never be fully realized.

FARNHAM HOP GARDEN.

SECTION IV.

THE FOOD, DISEASES, AND REMEDIES OF PLANTS.

Plants derive their nutriment from two sources and through two mediums—from the earth, through their roots; and from the air, through their leaves. The air furnishes, directly or indirectly, by far the largest portion of food to plants; for even part of that which the earth supplies is attracted from the atmosphere. We have seen that the organism of plants is formed for imbibing and assimilating the materials presented to them; and although the precise nature of the faculty by which they exercise the power to appropriate their food is a mystery, no one doubts the fact; and a farmer is as well aware of the necessity of supplying it to *them* as to his cattle.

The nutriment of plants consists of mineral, or inorganic, and atmospheric, or organic substances. Decomposed animal and vegetable matters supply large quantities of both, in the form of gases and more solid materials. The earth, from its own constituents, furnishes but a very small proportion of the food of plants. The experiment of Van Helmont appears conclusive on that point. He dried and weighed off 200 lbs. of mould, which being placed in a box, he planted therein a willow sapling, weighing five pounds, which he watered with distilled water, covering it with a perforated tin cover, to prevent any other earth from getting into the box. At the end of five years (the leaves being every year taken account of) he weighed the tree, and, adding to it the weight of the leaves, it amounted to 169 lbs. 3 oz.; but on drying and weighing the earth, it was found to have lost only two ounces of its original weight.

It has been already shown that carbon, oxygen, hydrogen, and nitrogen constitute the largest portion of both plants and animals. Plants receive carbon and nitrogen chiefly from the air—the first, in the form of carbonic acid; the second, in that of ammonia. Hydrogen is derived from water. The inorganic or mineral constituents of plants are all obtained from the soil, in which, being chemically dissolved, they are received by the roots and converted into sap, which performs an office in the plant analogous to that of the blood in animals. During summer, and especially the early part of that season, the action of the sap is vigorous, and sustains the growth of the plant, and the development of its branches and foliage. But as the year advances, and the sun declines, and the temperature lowers, the sap gradually loses its vital force. The leaves then, being deprived of their usual supply of nutriment, first turn brown or red, then yellow, and finally fall from the trees as winter approaches.

When a fall of rain takes place, it is absorbed by the leaves, and a descent of sap succeeds through the vessels prepared for the purpose. The transpiration of plants is the exuding of a watery fluid, exhaled through the leaves. The sap ascends during the day, while the sun exerts its influence, and descends during the night, when the temperature is materially lowered. Whatever soil a plant may be placed in, the sap has been found by experiment to be the same, proving that a plant will only absorb and assimilate those matters that are congenial to its nature and tastes. There is but little difference in the nature and constituents of the sap in different plants, although they differ widely in the proportions of the substances it contains. Thus, the sap of the sugar-cane, the maple, the beetroot, and the sorgho contain larger proportions of the saccharine principles than any other known plants. Homberg cultivated cresses in pots, some of which contained earth mixed with saltpetre, and others with washed earth, and he found that, in both, the cresses throve alike, and exhibited no signs in their flavour of the difference in the soil.

When plants are exposed to the action of fire, the organic constituents—carbon, hydrogen, oxygen, and nitrogen—are disengaged and fly off, and are thence termed the combustible constituents. The ashes which remain consist, as we have seen, of phosphoric acid, potash, silica, sulphuric acid, lime, magnesia, iron, and chloride of sodium, or common salt. These are termed incombustible, for a similar reason, that they do not yield to the action of fire. Small as are the ashes of the most solid substances, they are equally essential to the health and life of the organisms in which they are found. In cereal crops the proportions of the inorganic constituents are appropriated in much the largest proportion in the straw. Thus, in wheat the proportion of ashes in a crop (according to Boussingault's experiments) was 68·1 in the grain, to 388·5 in the straw, the entire weight of the grain being 6·312 pounds, and that of the straw 12·432 pounds. The proportions of the organic materials were nearly alike, according to the weight of the two products, with the exception of the nitrogen, which was nearly six times greater in the grain than in the straw.

Phosphoric acid enters largely into the composition of grain and seeds. In a soil, therefore, which contains no phosphates, there can be no grain. On the other hand, plants that are not allowed to form their seeds contain but little phosphoric acid. Such is the case with turnips, beetroots, cabbages, &c., consumed in winter, and this is the reason why such crops are justly considered a good preparation for one of cereals. They are in general heavily manured with matters containing a large portion of phosphoric acid, which, as they do not appropriate it, is left in the soil. On the other hand, they *do* absorb a large proportion of other matters in the manure, and leave less for the ensuing crop. But as the object of the farmer is to produce grain, and not straw, and the soil still retains enough of the constituents necessary to produce a sufficient quantity of straw, it is not advisable to add more manure in such cases, as it would cause the straw to preponderate, to the injury of the grain.

Alkaline salts, and those of lime and magnesia (according to Liebig), are equally essential to the growth of peas, beans, beetroot, &c. By experiment, he found that the following were the proportions of those substances taken up by different plants :—

	Alkaline salts.	Salts of lime, &c.	Silica.
A crop of wheat	120½ lbs.	78½ lbs.	260
A crop of peas	198½ „	371½ „	46
A crop of beetroot without the leaves . .	361 „	37¾ „	

The leaves of plants perform functions something similar to the lungs of animals. They inhale carbonic acid from the air, retaining the carbon and giving back the oxygen with which it was combined. They divest water of its oxygen in the same manner, retaining only the hydrogen. The atmosphere consists of 9 of oxygen to 1 of hydrogen, with a small proportion of carbonic acid (2 parts to 10,000 parts of air). The atmosphere being 40 miles high, and giving 15 lbs. to every square inch of surface, or 94,089,600 lbs. to the acre,—which, reckoning 2 lbs. to every 10,000, gives 18,817 lbs. of carbonic acid per acre,—would supply twenty times the vegetation grown upon that quantity of land, as it is continually being renewed by the decay and decomposition of animal and vegetable substances. Farm-yard manure consists of these substances, which also contain a proportion of the constituents of the soil. "The excrements of men and animals represent the ashes of the food consumed by them, and which are oxydized or burned in their bodies. The urine contains the soluble, the solid excretæ the insoluble constituents of the soil derived from the crops used as food, and reaped from the soil. It is plain that by adding manure, or liquid and solid excretæ, to the soil, that soil recovers those constituents which have been removed from it by the crops. Thus the restoration of its original composition is accomplished by restoring its fertility. It is therefore certain that one of the conditions of fertility in a soil, is the presence in it of certain mineral constituents. A rich and fertile soil contains more of them than does a poor and barren one."*

The absorption of carbonic acid and ammonia is not confined, according to the same authority, to the leaves of plants. The roots also possess the faculty of absorbing and assimilating them in their organism in the same way as when absorbed by the leaves. The ammonia which is contained in, or brought by means of rain, &c., into, the soil, plays the part of a constituent of it. This is also true of the carbonic acid in the soil. All plants, without exception, require for their nutrition phosphoric acid, sulphuric acid, the alkalies, lime, magnesia, and iron. Some important genera require silica. Those which grow on the sea-shore, and in the sea, require common salt, soda, and iodides of

* Liebig.

metals. In some genera the alkalies may be in part replaced by lime and magnesia, or these latter by alkalies. All these substances are included in the term mineral food of plants. Carbonic acid and ammonia are the atmospheric food of vegetables. Water serves both as a nutritive substance and as a solvent, and, in the latter capacity, is indispensable to the whole process of nutrition.

Carbonic acid and ammonia are supplied to the soil in abundance in the decomposition of the animal and vegetable substances of manure; and their presence is considered indispensable in the preparation of the mineral constituents for entering into the organism of the plant, these latter being insoluble of themselves in water. It is, however, by no means decided by scientific men whether manures act in the soil as *stimulants* or as *constituents* in the nutrition of plants. The probability is that they serve both purposes. In assisting, as has just been stated, in dissolving the mineral constituents, they act as stimulants; at the same time, by the evolvement of carbonic acid and ammoniacal salts, and other nutritive substances, they act as constituents in nutrition. The properties of a fertile soil are divided by chemists into physical and chemical. The physical properties are colour, density, porosity, stiffness, or lightness. The chemical are those by virtue of which the constituents are enabled to enter into chemical combinations or effect the decomposition of mineral matters. That these different properties harmonise and assist each other in the process of the nutrition of plants is evident from the fact that if any of them are absent the plant cannot sustain its vigour. At the same time, the physical powers by themselves can produce no effect in the process of nutrition. "A soil may possess the best physical qualities and yet be barren. In order to be fertile, it must contain substances of certain chemical properties, and its physical character must be such as to allow these chemical properties to be manifested. If a soil, from being very stiff, does not allow the roots to spread, the roots cannot reach the substances they require as food. If it do not permit water to percolate freely through it, the nutritious substances cannot reach the roots."*

Cultivation, therefore, is necessary to enable plants to avail themselves of both the mineral and the chemical constituents of the soil. A clay soil is perhaps the best that can be for the production of cereals, when properly tilled; and yet, if such tillage is not rendered, or is imperfectly or insufficiently rendered, plants cannot avail themselves of the nutrition it contains. Such soils,—and to a greater or less extent, *all* soils,—without proper tillage, present both a chemical and a mechanical resistance, because their particles not being properly separated, the chemical solvents cannot act, so as to render the mineral substances available as nutrition. The soil must be rendered permeable, so as to admit the air to penetrate and the water to filtrate through it. By this means the solvents are introduced into, and act upon, every part; and a soil which before was absolutely unfit for vegetation, becomes rich and productive. A close, impermeable soil is the most unprofitable to farm if the cultivation of it extends only to a superficial tillage. The water is retained in a stagnant state, repelling the sun's rays, keeping down the temperature of the earth, poisoning the plants, and neutralising the action or excluding the presence of the solvents, which cannot operate upon the adhesive and unbroken clods of which such a soil is composed.

Manures are beneficial to a soil in proportion to the amount of tillage bestowed upon it. Whether they act as nutriment direct and *per se*, or indirectly as stimulants

* Liebig.

to the atmospheric and mineral constituents of plants, or in both capacities, their good effects are but half developed if the land is imperfectly cultivated. On the other hand, a soil rich in the mineral constituents will produce excellent crops with the help of good tillage without manure. Jethro Tull was the first to prove this by growing crops of wheat for at least fourteen consecutive years without manure, but with constant stirring of the ground, so as to admit the light and air. Chemistry had not then shed its luminous rays upon the human mind, but the chemistry of nature came in aid of the precocious discernment of Tull (for he was a century in advance of his age), and seconded his efforts. Those who have now adopted this theory in the present day, have improved upon Tull's plan by adding deeper tillage, bringing yearly a portion of the subsoil to the surface, by which means not only are the pores of the soil opened to admit the air and dismiss the water, but the roots of plants are enabled to penetrate deeper and obtain a stronger hold on the soil, whilst fresh supplies of the mineral elements are constantly brought to the surface to nourish the plants with their proper food. It would appear that cultivation is alone sufficient to attract the organic or atmospheric constituents in quantities large enough to keep up the fertility of the soil and produce a good crop. Mr. Smith, of Lois-weedon, has for fourteen years grown wheat on the same land nominally without manure, and has found that the soil has not in any respect been deteriorated by it, the deep and continuous tillage and alternate fallowing of half the land being quite sufficient to sustain its fertility.

That fertility, however, has certainly not been sustained without manure, because the constant agitation of the soil by the fork or the spade has rendered it doubly absorbent of the elements of fertility contained in the atmosphere, as nitric acid, carbonic acid, phosphoric acid, ammonia, &c. The soil has therefore been manured to the extent of nature's efforts, assisted by constant tillage, as effectually as if an actual supply of manure had been laid upon it. The error of the advocates of the system lies in the inference they draw from it—that manure is an unnecessary expense in farming. It is true that remunerating crops of wheat, &c., can be produced by this system; and, besides, a principle is thereby established, that the atmosphere supplies the organic constituents of plants in sufficient amount to sustain the natural fertility of the soil; and also that a rotation of crops is not a necessary condition for that purpose. Experience shows, however, that with the addition of a suitable supply of manure applied at a proper time, the fertility would be largely increased, and much heavier crops produced. A thousand instances can be adduced in which poor soils have by this means been made to produce much larger crops of wheat than the average of the Lois-weedon land.

Purely vegetable manures are found to be highly promotive of fertility, and the system of growing green crops for the purpose of ploughing them in as manure is now commonly practised. It has been proved that the cutting of a second crop of clover is more beneficial to the after-crop of wheat than if it was fed off with sheep. Mr. Nesbit, in his excellent lecture on the nature and application of manures, mentions a remarkable instance in proof of this, and explains also the cause. Speaking on the subject, he says, "A friend of mine tried this in Northamptonshire. He had a field of clover which he divided into two parts. The whole was cut at midsummer, half was left to grow again, and the other fed off. In October he staked out two pieces as regularly as possible, and had all the roots dug up, and carefully cleaned, and weighed. The result was, that where the clover had been cut once and eaten once, there were twenty-five hundredweight of roots per acre; and where it had been cut twice there were seventy-five hundredweight per acre, being a difference of two tons (and a half) of roots. Who will say, then, that two (and a half) tons of vegetable matter, containing so much nitrogen as these roots do, were not an exceeding good dressing? Of course the result in the wheat-crops was perceptible at once, and you may depend upon it that, with one exception—namely, where soils are so light that the mechanical treading of the feet of sheep is a matter of prime necessity—you will always get a better crop of wheat after two cuts of clover than by feeding off."*

Farm-yard manure, strictly speaking, of whatever kind, consists wholly of materials derived from the soil, and is therefore proper to form the constituents of plants. As this is generally managed, a large proportion of the most valuable elements of which it is composed, being volatile in their nature, are suffered to be dissipated before the manure is applied to the land. If fermentation is allowed to proceed freely, without any precautions for fixing the ammonia, its most important constituent, the mass is rendered less effective in exact proportion to the loss of that material. To prevent the dispersion of these more valuable parts of the dunghill it should be placed under cover, and when fermentation commences, a coating of common salt, or one of sulphate of iron (commonly called green copperas), should be laid over it.† Either of these will absorb and fix the ammonia, and convert the absorbents into ammoniacal salts. An absurd idea is cherished by many farmers ignorant of the nature and properties of the chemical constituents of manures, that the more powerful the effluvia arising from a dunghill the better will be the manure. The real fact is, that the smell arises from the evaporation of the most valuable materials driven off by the decomposition which has commenced. Lime also is useful in absorbing and fixing the nitric acid or ammonia in dunghills, or in the soil. Calcareous matter is an essential ingredient in every soil, and it is an excellent plan to apply it constantly by covering the dunghill with a thick coating of it, which will both assist in the preservation of the ammonia, and impart *per se* a valuable material to the mass.

Fermentation is the agent employed by nature, not only to rid itself of dead organisms which in their collective capacity can no longer be of any use, but also to purify and prepare their constituent parts by separation for future service. For whatever the degree of separation and dissipation to which dead animal and vegetable substances may be subjected, not the smallest portion of them is annihilated or lost to nature. However minutely they may be divided, however volatile the particles into which they are separated, and however widely they may be dispersed, not one of those particles but is fitted and prepared by that very decomposition which appears to have destroyed them, to enter into new organisms, and again to reappear in all the renovated beauty of youth, and all the fulness of the vital forces,—active in the animal, passive in the vegetable.

This extreme divisibility and indestructibility of matter constitutes one of the first principles of the universe, one of the first laws of nature, for by it the unbroken succession of organic life is provided for and ensured. It is of these particles or

* "Nesbit's Lectures," p. 18.

† Baron Peers, a Belgian nobleman, whom we have already spoken of, has found that the manure treated with sulphate of iron was much more powerful than that without it. He tried an experiment upon a crop of ruta baga, part of which he planted with a dressing of common dung, and an equal part with dung treated with sulphate of iron. The difference in the crop was equal to 3,000 kilogrammes per hectare, or more than twenty-four hundredweight per acre.

molecules that the food of plants consists in the various forms in which we have represented it. Every one of them has its location and its function in the vegetable economy, every one is necessary to the health and well-being of the plant, and to fit it for the use of man, either direct or through the agency of the inferior animals. It is the business of the agriculturist to husband these molecules, and to prevent as far as possible their dispersion by the application of those means that have been found effectual in fixing the volatile, and thereby rendering more valuable the solid, portions of manure.

We have next to speak of the diseases of plants, which in a state of high cultivation display a greater or less predisposition to be affected by them, on the same principle that high living in animals produces a similar tendency. Extremes, in fact, whether in excess or in abstinence, are alike prejudicial to the healthy development of the structure of both plants and animals; but of the two excess is ultimately the most so, and the least capable of being counteracted or remedied, because the system is forced beyond its natural limits, superinducing a morbid condition of the vessels, and destroying the balance of the constitution. These effects have been proved by the microscope, which detects in the vessels and cells of plants the seat, the causes, and the progress of disease. From such investigations it has been found that diseases arise—"1st, from an excess or a deficiency of the agents necessary to the vigorous growth of plants, as soil, light, heat, air, moisture, &c.; 2nd, from the attacks of parasites, especially the fungi class of plants; 3rd, from the action of poisons taken up from the soil or inhaled from the atmosphere; 4th, from the mechanical injuries caused by the attacks of insects."

The first is called by naturalists epidemic disease. Defective or insufficient nourishment renders plants liable to the attacks of parasitic plants, which prey upon the juices, and deprive them still further of nutritive support. Stagnant water in the soil for want of drainage chills the plants and prevents a healthy development of their parts. Excessive cold, as well as heat, especially at the time of blooming, destroys the fructifying principle, and renders the stamens and pistils abortive; and too much moisture produces a kind of dropsy, and causes the foliage to fall off.

The mildew, which is the effect of fungi, is brought on either in the spring of the year by the cold east winds after a hot day, or more frequently by cold wet weather in the summer after the grain has formed in the ear. An excess of moisture causes an abundant rush of sap during the day, which is checked by the cold; and the spores of the fungi, wafted by the wind, making a lodgment on the outward bark or epidermis, enter the cells and vessels, where, finding abundant nourishment, they spread rapidly, to the destruction of the grain. It is not the cereal plants alone that are affected by the mildew, almost every hedgerow plant is more or less liable to the disease, and the spores from these are constantly flying about in all directions, by which the cultivated crops are continually liable to be inoculated. Fastening themselves upon the rind, they insinuate into the tissues the ramifications of their radicles, and extract from them the nourishment required to fill the grain. If they attack the plant at an early period of its growth, the crop is entirely destroyed; if at a late period of its growth, the grain is shrivelled and light in weight.

The pepper brand (bunt, or smut ball) is produced by a plant named by De Candolle *uredo caries*, and by Bauer *uredo fœtida*. It attacks the grain of the wheat in the form of minute dark-coloured globules, attached to each other by a threadlike matter. The spores, which are in the form of powder, have a nauseous smell. The disease is said to be propagated by contact. This species of smut is not the worst the farmer has to contend with, because it generally remains whole after the grain is threshed, and may be easily separated by a careful dressing. The hardness of the skin prevents its being always broken by the flail, and being much lighter than the perfect grain, it will fly off with the chaff, or the thin kernels of wheat. If allowed to continue in the bulk it spoils the sample of grain, and the colour and quality of the flour.

The dust brand or smut is also caused by a fungus called *uredo segetum*. The spores of this plant are of the same dark colour, but have no fetid smell. The flowers of wheat and barley are rendered abortive by it, and the pedicles become fleshy, affording nourishment to the spores, which finally appear between the chaff scales in the form of a black dust. This species of smut is much more injurious than the pepper or bladder brand, because, being ripened before the grain, the dust is dispersed by the wind, and attaching itself to the sound ears taints the whole crop. In this case the grain becomes "nibbed," that is, the spores attach themselves to the upper end of the kernel, which being hairy affords a lodgment for it, from whence it is very difficult to separate it in dressing, and the flour is consequently injured by it.

The rust (red robin, red gum, &c.) is caused by a fungus called *uredo rubigo*. It appears in the form of red, yellow, or brown spots, of an oval shape, on the stem, leaves, and chaff of wheat, grass, &c. It acts the same as all this class of plants, by intercepting the sap between the roots and the ear, and thus depriving the latter of the nourishment necessary to its full formation.

Mildew is caused by a fungus called *puccinia graminis*. The spores of this plant are contained in a club-shaped vesicle, the thick end of which is divided into two chambers or cells, the smaller end being attached to the epidermis of the wheat by its roots. All this class of plants affect the grain, &c., in the same way, by first destroying the epidermis, and drawing off the weakened supply of sap from the ear, by which the grain becomes shrivelled and only half filled with starch, or else wholly destroyed as by the smut. Professor Henslow recommends for this disease (mildew) that the seed wheat should be steeped in a solution of sulphate of copper, in the proportion of an ounce to a gallon of water for every bushel of wheat. This will destroy the seeds of the fungi without injuring the grain. But while so many of the wild plants with which the hedge-rows abound, are liable to the same disease (even to the bramble and the wild rose) the corn will still be liable, when the season serves, to its attacks. The wild plants must therefore also be destroyed in order to eradicate the disease.

Ergot (the French word for a cock's spur) is also considered to be the effect of a fungus, inducing a diseased state of the ovaries. It is most common in rye, but sometimes attacks wheat and barley in a curved form of the ovary, resembling a cock's spur, of a black colour, spongy, and containing an oily matter. This disease is not very common in this country, but we believe it is frequently prevalent on the Continent, where rye is more generally cultivated.

Although the foregoing class of diseases are to a great extent dependent for their existence upon atmospheric phenomena, and are in force to a greater or less extent, or altogether absent, according to the temperature of the air at certain critical seasons of the growth of the plants affected by them, it is certain that they, as well as the epidemics in man or the inferior animals, are greatly aggravated, if not absolutely originated, by a tardy, slovenly, and imperfect cultivation, and especially where drainage has been neglected. This last work is as necessary for the healtn of the fields as it is for that of our cities and towns; and there is not a doubt that if the land were generally drained, many of the diseases of plants would disappear altogether, or become so modified in their character as to inflict infinitely less mischief upon the cereal crops. At the same time, to mitigate still further the evil, and prevent contagion, the hedges and highways must be cleared of those plants that are similarly affected by them. Late sown winter wheat, on undrained land, is that which suffers most from these blights. The land, soaked with stagnant water, has not genial warmth enough in it to produce a rapid or healthy vegetation, and the roots get chilled, which throws back the progress of the plants, and renders them doubly liable to the attacks of their enemies.

The root-fall is a disease that attacks the wheat in the spring of the year after a severe frost. This is entirely a mechanical disease (if such it can be called) arising from the neglect of the farmer. The *rationale* of the affection is as follows:—During the autumn, the rain, which usually falls, swells the soil and raises the roots of the wheat with it. If the wheat has been sown late, the tap-root has not had time to strike down, and the whole plant is raised towards the surface. If a protracted frost succeeds, the soil is frozen in the position in which it stands. The frost evaporates the moisture, so that when a thaw comes, the particles of soil fall (not being sustained by the moisture), and thus leave the roots bare and exposed to the vicissitudes of the weather, and unless the earth is closed round the plants by rolling or the treading of sheep, the probability is that a large proportion of the plants will be destroyed. The poor lands are particularly liable to this disease, on account of the lightness of the soil.

The potatoe disease has hitherto baffled the efforts of both scientific and practical men to discover and define its real nature and origin. Berkely ascribes it to the fungus *Botrytis infectans*,* the spores of which, entering the stomata of the plant, cause first disease in the leaves, which afterwards extends to the tubers. Crum attributes the disease of the tubers to the rupture of the starch-cells, and the consequent mixture of their contents with nitrogenous matters, causing fermentation; but he does not tell us how the cells became ruptured, which is the most important point. Solly ascribes the disease to the presence of putrifying azotised matters in the stem just below the surface of the ground, which being carried to all parts of the plant, cause a struggle between vital and chemical forces, inducing decomposition by fermentation. Liebig considers that it arises from interrupted transpiration depending on the hygrometrical (or damp) state of the atmosphere, producing a want of correspondence between absorption and transpiration, and a consequent stagnation and decomposition of the juices. These differences of opinion go far to prove that nothing certain is known about it, and that the really exciting original cause is as much an enigma as ever.

* With regard to the *Botrytis infectans*, that it is found on the stalks of the diseased potatoes is clear; but that it is the cause of the disease has been by no means demonstrated, it being very possible that it is the effect instead of the cause. It is well known by naturalists, that the *fungi* tribe of plants always insinuate themselves wherever disease has attacked either a plant or an animal; and the leaves and stalks of the potato having received injury from atmospheric phenomena, would be likely to form a *nidus* for the spores of the *Botrytis*. The writer in Morton's "Cyclopædia of Agriculture" thinks that the *Botrytis* is first propagated *within* the plant; but if so, how did the spores insinuate themselves unless the bark had been injured and broken? He admits that the experiments he had instituted had not been attended with success; and it will probably require an incessant observation of the progress of the plant from day to day to obtain an insight into the real state of the question, and even this may fail. It is remarkable that the *Botrytis* is peculiar to the tribe of plants only of which the potato is a member, and that it has never been found on any other family of plants.

In the year 1848 a commission was appointed by government in Ireland to investigate the disease, and, if possible, discover its true cause, so as to be able to suggest a remedy. Sir Robert Kane was the leading member of the commission; and if science and discernment in natural history could have effected the object, we should have been at that time put in possession of what was required. After spending many weeks, and much money, in the investigation, the commissioners left the question very nearly as they found it, and were compelled to state that the disease was an unfathomable mystery from beginning to end; and thus it has continued to the present time.

There is reason, however, to think that electricity has a considerable share in producing the disease; and this opinion, founded wholly on observation, is gaining ground amongst practical men. In the year 1848, during his residence in Ireland, the writer of this work occupied some land in Dublin, adjoining to which was a field bearing a remarkably fine and sound crop of potatoes. They were of the early kind, and the owner of the field had begun to raise them. On the 15th or 17th of July, at night, there occurred a heavy storm of thunder and lightning, and the next morning the potatoes, the tops of which previously had been a bright green, had turned black throughout the field; and in a very few days there was hardly a sound tuber in the whole crop. It is very possible that, in other cases, other causes may contribute to the origin of the disease; but in this instance, the writer has no hesitation in ascribing it to the electric fluid; at the same time he does not pretend to account for its effect upon scientific principles.

Many plans have been suggested for preventing or arresting the disease, and isolated cases have occurred in which most of them have succeeded; but there are more, we believe, in which they have all failed to produce any beneficial effect. Klotzsch recommends pinching off the tops of the branches, which checks them, increases the development of the tubers, and strengthens the leaves and stalks. Tombelli Lomba, of Namur, states that he saved his crop by cutting off all the haulm, after flowering, with a sharp sickle, and covering the ground with a layer of fresh mould an inch and a half deep, after removing the haulm. The potatoes were of good size and quality. This plan of cutting off the stalks is still recommended, but has in many instances failed of producing any benefit. It has been thought that an entire change of seed would be beneficial, and one person procured tubers from the district of Quito, in South America, which is the native country of the potato. These grew very freely, but were found to be affected with the disease quite as much as the old stock.

Whatever may be the original cause of this strange and fatal disease, one thing is certain—that after fifteen years of its visitation, it is this season (1861) as rife and prevalent as it was in 1846-7, and appears as likely to continue in every country of Europe as any other epidemic. Diseases of various kinds have at different times attacked the potato—as the rust, the curl, the scab, the dry rot, &c.; but all these sink into insignificance in extent and duration compared with the potato murrain of which we have been writing, and which was unknown in the United Kingdom before the year 1845, but whose presence then and subsequently in Ireland proved an important episode in the sad history of that country.

Dodder (*Cuscuta*) is a parasitic plant, which attaches itself to flax, clover, trefoil, &c. The seed, which is exceedingly minute, is sown with those of the above plants, and where it vegetates it strikes its roots into the stalks of those plants, and draws from them the sap.

This disease, if such it can be called, has greatly prevailed of late years, and appears to be overspreading both England and France, for the French farmers complain much of its ravages on the clover. In some cases, so completely has it destroyed the crops, that it has been deemed expedient to set it on fire as it stood, as less loss and evil than allowing it to seed the ground, the clover itself being of little value with the dodder upon it.

We shall next advert to another class of diseases affecting the cereal crops, and frequently proving very destructive. They are the effect of insects, namely, the *Tipula maculosa*, the *Limax*, the *Chlorops*, the *Oscinis*, the *Scopula frumentatis*, the *Bembidium*.

The *Tipula maculosa*, or spotted crane-fly, is common on all arable lands, particularly on light gravelly or sandy soils, and on the sea-coasts. It frequents meadows, gardens, hedgerows, &c., and, in short, is almost an universal nuisance. In May, June, and July, the *larvæ* are very destructive to wheat, potatoes, &c. The fly, or gnat, is about an inch long in the body, which is a bright yellow, spotted with black in the head and trunk, with eight black spots down the back of the male, and six in the female.

There are several species of *Limax*, as the *Limax agrestis* (or milky slug); this is whitish, or ash-coloured, with black tentacula, either immaculate or with scattered black spots and a yellowish shield.

The *Limax ater* (or black slug) is furrowed with deep wrinkles, and has a rough shield. It is sometimes a deep black on the back, pale or white beneath, with a yellowish mouth, and a pale greenish ridge down the back; or of a dusty or chestnut-brown, with a yellow streak on each side.

The *Limax maximus* (or black striped slug) is five inches in length, cinereous, sometimes spotted, or with a black shield; the body striped black, or with five whitish streaks, the lower one interrupted, or with the body edged with white.

The *Chlorops lineata* (or striped wheat-fly) lays its eggs in June, at the lower part of the ear. These are hatched in fifteen days, when the maggots pierce the straw and work upwards to the grain, which they devour. The pupa is brown, and the fly is produced in September. It lays its eggs on the young plants of wheat and rye in the autumn. It has yellow horns and a triangle on the crown; the thorax is black, with five black stripes on the abdomen, with dusky bands, and a dot on each side at the base; apex and legs yellow, &c.

The *Chlorops herpinii* only attacks the barley. It differs in other respects little from the foregoing.

The *Chlorops tencopus* (riband-footed corn-fly) is the most mischievous of all the enemies of the cereals. It attacks the joints of the straw, which then swell and become what is termed "gouty." The fly is of a pale yellow, horns black, and a black triangle on the crown; on the thorax are three broad black stripes, with a slender black stripe on each side, and a black dot on the side of the breast; abdomen a pale greenish black, forming four blackish bands, and two dots at the base; wings transparent; poisers white; legs ochreous; basal, and two terminal joints of fore feet, black; length 1½ line.* They deposit their eggs in the leaves in autumn; and in spring, when the maggots live in the base of the stem, they destroy the shoot, and thus render the ear unproductive.

There are three species of *Oscinis*. The *Oscinis granarius*, in its larva state, lives in the ear of wheat, the grain of which it devours. The fly is very diminutive, expanding

* A line is the tenth of an inch.

only two lines. It is of a blackish green colour, with small horns, and a large head; the thorax is a globose quadrate; the body conical; wings transparent and ample, similar to those of the *Chlorops*, but the dark costal nervure extends to the second apial one; club balancers ochreous; fore posterior legs black, &c.

Oscinis pumelionis (or rye worm-fly) has been very destructive to the rye-crop in Sweden. The larva inhabits the base of the stem, into the substance of which it eats, and kills the plant. The larva changes into a yellow pupa about the end of May, and the flies are hatched in June. They are one line in length, with yellow eyes and horns, and a triangle on the nape; thorax and body black above, the former with two yellow stripes down the back, &c.

Oscinis vastator is the most destructive to the wheat-crop of any of this tribe. The larvæ are found in the spring at the base of the stem of the plant, where they eat through the stem of the plumule, so that it can be drawn out without breaking it, and the embryo ear is destroyed; the plant, turning yellow, dies. The larva is yellow, tapering to the head, and blunt at the tail. The mouth is furnished with two black horny points. About midsummer they change to elliptical rusty pupæ within the folds of the leaves. The flies are hatched early in July, and are very similar to the *Oscinis granarius* in size and colour, being shining green-black. The wings lie flat on the back in repose, and extend considerably beyond the body. All the nervures are pitchy; the club of poisers ochreous; the base and tips of the four anterior shanks rusty, as well as the base of all the feet.

Although eaten down, the plants will sometimes tiller. The alternation of green crops and effectual tillage, are the best remedies for getting rid of these and all other insects. Successive crops of cereals encourage their increase; but they have an enemy in a small black parasitic fly, which deposits its eggs in the body of the *Oscinis*, where it lives and feeds upon its entrails, both increasing together; but the enemy comes forth a full-grown pupa, whilst the *Oscinis* is destroyed. The name of the fly is *Sigulphus caudatus*. Its colour is black, with the exception of the wings, which are transparent. The stigma and nervures are pitchy.

The *Aphis* (or plant louse) is one of the most troublesome of all insects, on account of its rapidity of increase, its universal prevalence, and its attacking almost every description of plants. There are several species of this insect, named according to the plant to which they attach themselves or show a preference. There is a good deal of mystery as to the source from which, in the spring or summer, the parent aphides are bred, or how the larvæ or eggs of so delicate a creature can bear and survive the severity of the winter. Showing themselves singly, in the first instance, upon the plants they prefer, they may be viewed as a sure indication of an approaching army, whose name is legion, and whose ravages are irresistible. As an illustration of their numbers, we may mention that, many years ago, a friend of the writer's invented a machine* for taking the aphides off the beans, a field of which, belonging to him, was almost covered with them. In the course of a day's work, two men, with this machine, took off *twelve bushels of aphides*, which were given to the pigs, who devoured them with great relish.

* This machine was nothiog more than a canvas bag, fixed to a light square wooden frame, the length sufficient to reach across the stetches from furrow to furrow. A man at each end, walking in the furrow, draws the bag by the frame over the beans, from which the aphides fall into it; and as it becomes filled with them, they are swept through a sort of purse at one end, into a tub, to be disposed of as the farmer thinks fit.

All the aphides which appear in the spring are females, and deposit their young (for at that season *only* they are viviparous) on the backs of the leaves. In the autumn they become oviparous, and lay their eggs also on the leaves and buds; but how they are preserved through the winter is a mystery.

Another peculiarity belonging to them is, that the females do not require to be impregnated by a male to become prolific, being already pregnant at their birth. If a nit is taken as soon as it is brought forth in spring, and kept entirely apart from all others, it will still produce young; and if the process is repeated with one of these, it will also be found reproductive, and so on. It may therefore be easily conceived (what every farmer and gardener knows to his cost) that their multiplication is beyond the power of numbers to represent. It is calculated by naturalists that one plant-louse might, in seven generations, produce 729,000,000; and Reaumur asserts that, of one species, a female would, in *five* generations, produce 6,000,000,000! No wonder then that a field is soon covered with them.

These insects are furnished with a beak, as the conductor of three bristles, the centre one being tubular, with which they pierce the tissues of the plant and draw off the sap, as with a syphon. This causes the leaves to curl up, which forms a sort of bower for the residence of the aphis. It is fortunate that the small birds, which some farmers view as their greatest pests, are at the same time the most determined enemies to these, as well as other insects. There are also many amongst the larger insects that live upon the aphis and devour great numbers—such as the ladybirds and their larvæ, the aphis-lion, the syrphus, &c. We shall now describe some of the principal species of these insects.

The *Aphis granaria* (or wheat plant-louse) feeds on all the cereal plants. It attacks the wheat after it is in ear, but while still green, and sucking away the sap impoverishes the grain, leaving little to ripen besides the bran. The male is green, the female a dull orange. The male has wings, the female is wingless (*apterous*). These latter are frequently found dead on the wheat ear, being killed by the *Aphidius arenæ*, a parasitic fly, which pierces and deposits its eggs in the body of the aphis, which then turns black and dies.

The *Aphis rapæ* (or turnip-leaf plant-louse) lives on the turnip in summer, and in July is found in abundance under the leaves. The winged or male insect has a greenish body, blackish head, transparent wings, &c. The apterous females are a bright green in the body, with black extremities of horns and legs.

The *Aphis floris rapæ* (turnip-flower plant-louse) is found on the flower-stalks of the white-loaf turnip in great numbers in July and August, and do great injury to the crop of seed. The male is green and black, the female a dull pea-green powdered with white.

The *Aphis dubia* (black-spotted turnip-leaf plant-louse) is found under the turnip-leaf with *A. rapæ,* and differs from it only in having black bands and spots about the body and some minor particulars.

The *Aphis brassica* (cabbage-leaf plant-louse) are found in swarms under the leaves of various crops of cabbages, but have a particular attachment to broccoli and savoys, generally appearing in July, and continuing till the end of November if a severe frost does not occur before to kill them. They sometimes attack the Swedish turnips, which are then destroyed by them. The male is pea-green in the body, with black horns, head, thorax, and legs. The female is of a yellowish green and white, spotted with black.

The *Aphis fabæ* (bean plant-louse, or black dolphin) seize upon the beans soon after they come into flower. In the first instance they secrete themselves in the buds, and not being then numerous their presence is not noticeable. Soon, however, with the prolific powers of the genus, they multiply to that extent as to render the whole crop black, and in multitudes of which we have already given an illustration. In the first instance they are all apterous (wingless), and soon spread over the stalks of the plants. The males then become winged, and convey themselves to other fields to commit fresh ravages. The colour of the male is a dull black; that of the females a bottle-green and black; the pupæ are black, spotted with white.

The *Aphis humily* (hop-fly), like the rest of the genus, appears at the end of May in single specimens upon the hop-plant, where it deposits its eggs or nits. Their numbers then increase with a rapidity measured by the season. If the weather favours them, they soon destroy the hopes of the planters, for by the middle or latter end of June the bines and leaves are swarming with them, and all hope of a successful year is abandoned. As if the calamity thereby occasioned was not enough, their progress is made the constant subject of gambling speculation, and thousands are annually lost and won by bets upon the amount of the duty likely to be collected upon the crops. This aphis differs from several of the former ones, in the females sometimes having wings. Their colour is chiefly green, spotted with black; the nits are a yellowish white, but become a deep green as they arrive at maturity.

The *Aphis zeæ* (Indian-corn plant-louse) appear in August, when they are found in clusters under the leaves of the maize; but as soon as the nights begin to be cold in September they disappear. They are of an ochreous colour on the head and trunk, with dark green back marbled with paler tint; the extremity of the body rose-coloured.

Vibrio tritici is an *infusoriam*, and is the cause of the disease in wheat called the ear cockles or purples. The eggs, which are very minute, are mixed with sap from the grain, and are hatched in the germen. The worms are first transparent, then become a yellowish white with several rings, and are one-fourth of an inch in length. In the cavities of the wheat the eggs are deposited, contained in filmy silky webs, which dissolve in water and liberate hundreds of the worms, which soon display their vitality. Such indeed is this vital power of the vibrio, that after being kept in a dried state for six years, upon being put into water they have become reanimated, and lived three months. Their ravages on the grain, when in numbers, are very great.

The *Altica nemorum* (the turnip beetle or fly) attacks the turnip plant when in the first leaf, and frequently destroys the crop. This insect is of a shining black, and the hinder legs are formed for skipping, which it uses on the approach of an enemy with as much activity as a flea, for which, upon a cursory view, it might be taken. It deposits its eggs on the rough leaves of the turnips which have had the good fortune of escaping its attacks in the first stage of their existence. It continues laying till the end of September, but can do no harm to the turnip, except in the earlier stage of its growth. The eggs are hatched in about ten days, the maggots living upon the sap of the leaves, the cuticle of which is pierced by them. The pupa buries itself in the ground, where it remains during the winter, unless turned up by the plough, and seized by the birds of prey. They always migrate against the wind in search of food; and as they are found in great numbers in the meadows and hedges from March to October, the farmer—especially a slovenly one—can never be safe from its visitations.

Some years ago a fly-trap was invented by the same person who invented the bag for taking the aphides off the beans. This trap was exhibited at the annual sheep-shearing at Holkham Hall, and was approved by every one who saw it at work, but we believe no one adopted it. It consisted, like the other, of a canvas bag, fixed to a frame running on wheels. The lip of the frame ran close to the ground, and it being pushed along by a man or boy, the beetle, upon its near approach, skipped according to its habit, and in descending was received into the bag.* Various other methods have been tried to destroy these insects by steeping the seed in liquids supposed to be obnoxious to them, or by sowing sulphur with the seed. We believe, however, that the banishment or destruction of such wild plants as harbour them in borders and hedgerows, and also using means to promote the rapid growth of the young turnip plant from the first seed to the rough leaf, will prove more effectual than any of the expedients commonly resorted to for the purpose.

The *Altica obscurella* is another species of the same beetle, and is found most numerous in gardens where it commits its ravages on the seedling cabbages, cauliflowers, &c. It sometimes also is found on the turnip in the field.

Altica consobrina (blue cabbage flea or beetle). This insect attacks also the seedling cabbages as well as the turnips, eating off the first leaves, and so destroying the plants. Horseradish and radishes are equally the subjects of its ravages. It is of a dark blue, and its body elliptical in form. Like all this tribe, it is formed for skipping, the hinder thighs having a strong elastic power which enables it to leap fifty times its own height. It is also furnished with ample wings for flight, when it has occasion to migrate from field to field.

The *Bembidium* is a small beetle, the larvæ of which do great damage to the wheat crops. It has strong jaws, small horns and eyes, six hairy legs, tubular tail, and four series of spines down the back and sides. In October the larvæ do great injury to the young wheat plants, which being cut round the sheath of the stem below the ground die. One-fifth of a crop in Suffolk has been destroyed by these insects.

Tenthredo (or the turnip caterpillar). This insect is the most destructive and the most rapid in its depredations upon the turnip crop of any of the various pests with which that plant is affected. It is believed to be a foreign insect, from the circumstance that whenever they have appeared in force in the United Kingdom, the flies from which the caterpillars proceed have been seen near the sea shore in such multitudes, that they darkened the air in their flight; and after alighting lay so thick on the ground in a quiescent state that they might have been shovelled up. Marshall, from whom we quote, states that they lay two inches thick, and might be raked up into heaps of any size.† The following is his description of this insect:—

Female fly.—*Antennæ*, or horn-like feelers, consist of nine joints, the third from the head, longer than the rest, measures one-eighth of an inch long, clubbed and black.

Head, with the eyes and two ear-like appendages, black.

Tentacula, or mouth feelers, four; amber-coloured, mouth whitish.

Wings—four; deflex; one-third of an inch long; light-coloured membrane with

* It has often been a subject of surprise and regret to the writer, that this plan never got into general use. Its efficiency he has himself been witness to, the inventor (who was his relative) having *never lost a crop of turnips after he began to use it*. A prize was awarded to him for the invention, and there the affair ended.

† "Rural Economy of Norfolk."

black nerves; upper wings with strong, black, clubbed nerves along the outer edges; under wings less nervous, projecting one-twentieth of an inch behind the apex.

Legs—six; amber; black feet, and five black articulations; hind legs three-tenths of an inch long.

Body (from the neck to the apex)—thirty-five-hundredths of an inch long; bright orange, except two diamond-shaped scutuli (scutcheons) or patches on the shoulders, black.

Thorax—less than one-third of the length of the whole body.

Abdomen—more than two-thirds of the body, and fixed to the thorax *without any insection;* its form is between the cone and the cylinder (the greatest diameter about half its length), composed of eight segments on the upper side, and six on the under side. Under the two imperfect segments lies the—

"*Pubes,* which opens under the last segment of the abdomen; also the *sting,* composed of three hanger-like instruments, with a spiral wrinkle winding from the point to the base, making ten or twelve revolutions; length about one-twentieth of an inch. Enclosed in a sheath, opening longitudinally, and reaching from the pubes to near the point of the tail, where it ends in a black speck. This sheath stands edgeway to, and projects somewhat below, the body, but is situated principally in a recess in the abdomen.

"The male fly.—The same as the female, except that its antennæ measure only one-tenth of an inch in length, its legs one-fourth, its body nearly three-tenths; and except that beneath the two imperfect segments lies a plain scale, covering the male organ of generation, which is enclosed in a cloven hoof-like capsule, which forms the point of the tail. In the act of copulation the two claws of the hoof expand, and in some measure embrace the female. The penis is cylindrical, short, and of a transparent cartilaginous substance."*

That these flies come from some foreign country there is every reason to believe; not only have they been seen on land as we have described, but fishermen assured Marshall that they had seen them at sea in perfect clouds, whilst great numbers had been washed ashore, apparently having been dashed into the sea by the wind, or dropped in from fatigue before they could make land. After resting awhile on shore they disperse themselves over the neighbouring turnip-fields, where they deposit their eggs on the under-side of the leaves in such numbers, and so regularly over a field, that when the caterpillars are hatched, the whole is attacked simultaneously, and in a few days is completely denuded of every portion of leaf except the bare ribs. It is generally the latter end of July or the beginning of August that they make their appearance, and as it frequently happens that by that time the turnips have been hoed once, and sometimes twice, the loss falls very heavily upon the farmer. The writer had once a field of ten acres, that had been twice hoed, entirely destroyed in three or four days, for they never recover from the effects. Fortunately, the visits of these destructive insects are like those of angels, "few and far between," which is another reason to believe them exotics. Various means have been used to destroy them. Some have strewn lime over the leaves at night while the plants were moist with dew; others use soot in the same mode of application. Rolling has been tried, and hand-picking; and in some cases a trench has been dug to prevent them from migrating. All these

* "Rural Economy of Norfolk," vol. ii. p. 303.

means have failed of producing the desired effect. The only plan which appears to have been successful is that of turning a drove of ducks into the field affected. These birds will gorge themselves with the caterpillars to that degree as to make themselves sick, by which having cleared their stomachs they commence filling them again, with a similar result. Several farmers have saved their turnips by this method, when attacked by the caterpillar.

Marshall made a curious experiment to test the tenacity of life of this fly. He cut off the head of a female on a Saturday morning and kept it *alive* until the following Tuesday evening, having then lived three days and a half without a head, and performed the function of dressing its wings with its legs to the last, with the same briskness as before. What is still more remarkable is that several of its companions which were not headless had died in the interim, and the whole of those he had kept in a box died within thirty-six hours after the headless one, "so that it may be a moot point," he observes, "whether cutting off its head shortened or lengthened its days! Its life must have been merely vegetative, and the care of its wings pure instinct."

SECTION V.

AGRICULTURAL CHEMISTRY.

The history of chemistry as a true science is not of ancient date. The knowledge of its correct principles cannot be traced further back than the latter half of the seventeenth century, when Bucher first arranged and placed them on the sound and natural basis they now occupy. Bucher was succeeded by Stahl (his pupil), Boerhaave, Margraaf, Magner (who published the first chemical dictionary in 1760, and thus gave the science a classical nomenclature), and Bergman. This latter possessed a highly philosophic mind, well versed in mathematical knowledge, which enabled him to test the accuracy of the results of his experiments. Assisted by Scheele, his pupil—the one distinguished by the extent of his views, and the breadth of his plans for the advancement of science, the other by the skill and accuracy with which he conducted the analyses, and the acuteness and precision he displayed in detecting substances by their properties—they may be said to have raised the walls of that building, of which Bucher and Stahl laid the foundation; and the finishing and utilisation of which has called forth the talents of a host of men of mark, who have finally united chemistry with the civil arts, and thereby brought the science home to the every-day business of life.

Its progress the last hundred years has been rapid. Black first discovered the laws of pneumatics; Cavendish, the composition of water; and he was the first to apply electricity in chemistry. Priestley discovered oxygen in 1774; Brandt, phosphorus; Dr. Hook, combustion; Franklin, the identity of lightning with electricity, and its control and direction by the use of conductors; Watson, the simultaneous operation of the electric shock; Henschenbroek, the Leyden phial; Privati and Winkelmann, the application of electricity in the cure of chronic disease; Volta, with La Place, the voltaic battery, of which the galvanic battery of Galvani is the completion.

It has so happened that agriculture was the last of the arts to which the science of chemistry was *professionally* applied; and, what is more remarkable, its application was, up to a late period, opposed to the opinions of some of the most eminent agriculturists. While so far back as the seventeenth century we meet in history with isolated individuals endeavouring to accommodate the crude and erroneous notions they entertained on the subject with the laws of vegetable life and production, we hear the secretary of the Board of Agriculture, at the close of the eighteenth, questioning the utility of applying chemistry to agriculture. But at the opening of the present century, Sir Humphrey Davy commenced that useful career, which, while it has immortalised his name as the "father of agricultural chemistry," has raised the cultivation of the earth to a science, and completely changed the character of the men who practise it.

The grand object of agricultural chemistry is to ascertain the existence or non-existence of the relative conditions requisite in the three great elements of production—soil, seed, and manure; soil as the medium, seed as the subject, manure as the stimulant, or promoter, of production. A soil, for instance, may be very proper for the cultivation of a certain plant in many respects, and yet be deficient in its most essential constituent. The farmer knows nothing of this precise defect, and having, according to his views, fulfilled his part, wonders at his want of success. Chemistry here steps in, and by an analysis of the soil points out what is wanting and how to supply it. Again, certain plants require the presence of certain materials (lime, for instance), which must be supplied by proper manure containing them. But the farmer is neither acquainted with the exact want, nor with the means of supplying it, and he applies such manure as lies ready to his hand; and, like the former, he has a deficient crop where he expected a full one. Every farmer, it is true, cannot be a practical chemist, but every one now has it in his power, at a trifling expense, to obtain the requisite information from a practical chemist, so as to be able to conduct his business on scientific principles; and thus ensure, so far as human efforts can go, the success of his operations.

The analysis of soils is a necessary process, if it is desirable to ascertain their constitutional deficiencies or excellencies. A soil may be sterile on account of an excess of siliceous, or calcareous, or ferruginous, or argillaceous substances, or the deficiency of one or other of these; and the efforts of the husbandman are continually thwarted by the reduction of his produce to the minimum. Such defects in a soil can be at once, and correctly, ascertained by a chemical analysis, by which the cultivator is enabled to apply the proper remedy to counteract the evil. The objects of agriculture are the improvement and multiplication of the productions of the earth to the highest point of which their natures are capable; to attempt to attain these objects without possessing a knowledge of the materials with which we have to effect them, is contrary to all the acknowledged principles on which affairs in every other department of the arts are conducted. Yet up to a very recent period, such was the rule in the cultivation of the soil.

It is to chemical science that we owe all the improvements in agriculture and the increase of production of the last half century. Combining theory with practice, the chemists of the present day have united themselves with the practical husbandmen, going hand in hand with them in the progress of experiment, and the application of the principles established by their researches. By their exertions the domain of nature has been invaded and explored, her laws examined, her secret operations laid open and familiarised; and the knowledge thus acquired, carried out in practice, has effected greater and more important changes than the world ever before saw in the cultivation of the soil.

These changes are still in progress, for it is admitted on all hands that the acme of improvement and production are far from having been reached. We see the market-gardener, on a large scale, doubling and trebling the produce of the last century, at an enormous outlay, and acquiring riches by it. We see, too, that the most successful agriculturists are those who are the most lavish of their funds in the proper cultivation of the land. There is no reason, therefore, why farming should not be conducted profitably on the same principle as market-gardening, and the land made to produce double the crops they now do without being impoverished. If, as Professor Playfair assures us (and we may speak with confidence after such a man), a market-gardener can produce to the value of £250 from a single acre of land in one year, there can be no reason why a farmer cannot raise something more equivalent to it, than a produce of four or five quarters of wheat or barley on the same quantity of land.

We must still look to chemical science for the attainment of this object, for nothing can be effected without it. "Whoever," says Sir H. Davy, "reasons upon agriculture is obliged to recur to this science. He feels that it is scarcely possible to advance a step without it; and if he is satisfied with insufficient views, it is not because he prefers them to accurate knowledge, but generally because they are most current. If a person journeying in the night wishes to avoid being led astray by an *ignis-fatuus*, the most secure method is to carry a lamp in his own hand." . . . . "In proportion as science advances, all the principles become less complicated, and consequently more useful; and it is then that their application to the arts is most advantageously made. The common labourer can never be enlightened by the general doctrines of philosophy, but he will not refuse to adopt any practice, of the utility of which he is fully convinced, merely because it has been founded on these principles. . . . . The great purpose of chemical investigation in agriculture ought undoubtedly to be the discovery of improved methods of cultivation. But to this end general scientific principles and practical knowledge are alike necessary. The germs of discovery are often found in rational speculations, and industry is never so efficacious as when assisted by science."*

The slowness with which these great truths made progress amongst agriculturists is easier to account for than to justify or defend. Sir Humphrey Davy's researches met with little or no response from the "practical men," as they called themselves, of his day, and thirty years more were required to indoctrinate the farmers with the idea that chemistry and agriculture were inseparable. But in 1840 a scientific bomb was thrown amongst them, in the shape of a treatise on the subject by Baron Liebig, which excited as great a sensation as a real missile of that name would in the camp of an enemy. The public attention was intensely drawn to this theoretic work, which possessed the highest merit, but at the same time was calculated to raise too much the expectations of a class not yet emerged from an entire ignorance on the subject. The extravagant ideas formed by the "practical men" met with disappointment—not because Liebig's theory was erroneous, but because, in practice, it required to be modified to the existing

* "Agricultural Chemistry."

circumstances of the soil, &c., on which it was proposed to apply it. The immediate result was, that the bias in favour of agricultural chemistry, which had all at once sprung up, was exchanged into an absurd conviction that chemistry could not advantageously be applied to agriculture, and that the theories of the great chemist were not capable of being reduced to practice. Liebig's error (if it was one) lay in addressing the farmer as a man instructed in the science, and to whom his theory was as clearly demonstrable as it was to himself, or any other chemist; whilst, in fact, it required a far more advanced state of knowledge than the generality even of the most intelligent of the practical farmers possessed, to carry out his views to a successful issue.

About the same time, Boussingault published his celebrated work on rural economy, which, as soon as the disappointment arising from the failure in Liebig's case had subsided, drew the attention of the public once more to the subject. In this case, Boussingault had the advantage of being himself a practical, as well as theoretic, agriculturist, and tested the principles he advocated upon the largest scale, the experiments and results being given in detail in the work; and thus, theory and practice standing side by side, there could be no longer cavilling about it. Nobody now doubts the applicability of chemical knowledge to agriculture, or the benefits to be derived from it in the management of the farm. This result has been largely promoted by the institution of the "Agricultural Chemistry Association of Scotland," to which we have already referred when treating of Scottish agriculture. The warm reception which that measure met with from the Scottish farmers, speaks strongly in favour of their superior knowledge and intelligence. Similar associations were soon after formed in London, Dublin, Belfast, and on the Continent, by which a knowledge of the principles of chemistry was disseminated and extended far and wide. Since that period, the facts illustrative of the utility of conducting the processes of agriculture on chemical principles have accumulated daily; and the ice being broken, in which the practical men were bound up, many chemical professors find it to their interest to devote their time, talents, and industry in applying the principles of the science to the cultivation of the land.

The value of chemical knowledge meets the farmer at his very first entrance into business. In taking a farm, it is of the first consequence to him to make himself acquainted with the character of the soil, and its adaptation to the purposes of husbandry, which can only be ascertained by analysis. Soils are so diversified in their appearance and qualities, their combinations and their constituents are so varied in their proportions, that a farmer, going blindfold into a tract of land, is liable to be deceived and ruined before he discovers his error. We will illustrate this by two genuine instances of contrary practice. Very recently, a friend of the writer's was about to treat for a farm in South Wales, the land of which was represented by the agent as being well adapted to grow good crops of cereal produce. Before finally closing with the agent, he sent portions of the soil to an agricultural chemist, who soon informed him that there was so large a preponderance of oxide of iron, and so small a proportion of other essential constituents in it, that it was not at all adapted to cereal crops, and our friend at once broke off treating for it. In the other instance, three neighbouring farmers from Suffolk hired a tract of land of 600 acres in Ireland, the soil of which had the appearance of a deep black alluvial, capable of bearing any kind of crop. But upon entering on the land, they soon found that it had been so completely run out by the former tenant, and at the same time was so entirely destitute of calcareous matter of any kind, that for some years it gave a return of little more than the seed. Eventually, there being no lime to be procured in the neighbourhood, they were compelled to abandon the occupation altogether. Had they taken the precaution to obtain an analysis of the soil from an agricultural chemist of established reputation, they would have learned from him that the soil was totally unfit for the cultivation of cereal crops, although perhaps well adapted for growing roots.

One of the most remarkable effects or consequences of the publication of Liebig's work was the sudden extension of the use of artificial and mineral manures. It was well understood, by persons who had made the subject of consumption and production their study, that the ordinary resources of the farm in the promotion of the latter—at least so far as the common practice of husbandry was concerned—had reached their maximum, and that it had become necessary, if it was desirable and intended to extend production so as meet the requirements of an increasing population, to have recourse to science in aid of art. Not that the natural capabilities of the soil of England had been universally tested, for thorough draining and, as a preliminary step, arterial draining, were far from having been universally carried out, although it was well known that it was calculated to increase production indefinitely. In fact, arterial drainage, which, in Ireland, has been the means of doubling and trebling the value of hundreds of thousands of acres of land, is but now beginning to attract the attention of the English agriculturists. So far, therefore, the natural resources of the country had not been tested.

The use of condensed manures was previously limited to bone-dust, rape cake, woollen rags, and a few other substances in lesser quantities. But the astounding revelations of Baron Liebig led to the instant establishment of a vast number of concerns for the manufacture of special or chemical manures; and as the introduction of Peruvian guano took place about that time, and an analysis of it had disclosed its constituent parts, and chemistry had accounted for its prodigious fertility, many of the manufacturers professed to produce an artificial composition, similar, and equal in value, to guano. The estimation, too, in which that celebrated manure was held, led to the most villanous deceptions and adulterations, by which the unsuspecting farmers were robbed to an enormous extent. Not content with palming off their own worthless compositions at extravagant prices, the manufacturers adulterated the real guano with common red earth and other such cheap materials, in some instances, to the amount of 40 or 50 per cent. We shall have occasion to refer to this subject again when speaking of manures, and shall therefore only now state that these deceptions have been amply exposed by Mr. Nesbit, in a course of lectures delivered before different agricultural associations, by which the public have been put upon their guard against such robberies in future.

The reader will see, from what we have said, how important it is, not only to know the constituents of the soil by an analysis, but also those of the manure to be applied to it; and especially if that manure is to be purchased at a high price. The value of farm-yard manure is practically known by all farmers; but there are few who are acquainted with its constituents, or with their variations from accidental circumstances. Yet this is a most desirable thing to know, in order to be able to improve it, so as to adapt it to the crop for which it is intended. Lime, for instance, is useful in most cases; but in others it will have no effect whatever, or may be positively injurious, from being of a quality unadapted to the purpose.

The following directions are given by Boussingault for conducting the analysis of soils :—

"The attention must be directed—1st, to sand; 2nd, to clay; 3rd, to humus.

"The soil must be reduced to perfect dryness in an oil-bath in a copper vessel. The heat must be raised to 334° or 352° Fahr., which may be ascertained by a thermometer. Put the soil into a glass tube or a porcelain capsule; place the tube or capsule in the oil, having first taken the weight of the vessel and soil. Continue the drying for two or three hours, at the end of which weigh the capsule with its contents, taking care to wipe off the oil perfectly. Put it again in the bath for fifteen or twenty minutes, and weigh it a second time. If the weight has not diminished, it is a proof that it is perfectly dry. If otherwise, the drying must be continued, and the weighing be repeated twice, as before.

"Davy recommends putting the soil into a porcelain capsule, heated by a lamp, with a thermometer placed in the middle, to stir it with, and at the same time to indicate the degree of heat. The absolute desiccation could not take place at less than a red heat, or near it, which would destroy all the organic matter it contains. The earth must next be sifted, to remove the pieces of straw and roots, with the gravel and stones. Next, wash the earth in three or four times its bulk of hot distilled water; shake it well, and let it stand a moment; then pour off the liquid into a wide porcelain capsule. Continue adding fresh water until the whole of the clay is removed, which is known by the clearness of the water. What remains is sand, and must be washed out into another capsule. The water which contains the particles of clay and all other matters in suspension must then be filtered, and the residue dried in the same way as before. The sand also must be dried, and then both must be weighed.

"To ascertain the nature and quantity of soluble salts, the whole of the water used in washing must be put together and evaporated in a sand-bath. This must be continued to dryness, and the salts that remain, weighed, and thrown into a small platinum capsule, and heated to a dull red heat by means of a spirit-lamp, in order to burn out the organic or combustible salts, and thus be able to distinguish between them and the inorganic salts.

"The sand may be siliceous or calcareous. To ascertain the latter, use hydrochloric, nitric, or acetic acid. If it effervesces, it proves the presence of a carbonate, the quantity of which is ascertained by weighing the dry sand before and after its treatment with the acid, taking care to wash the remaining sand well before weighing it.

"To determine the quantity of *humus*, have recourse to heat. A known weight of dried earth is heated to redness in a capsule, and stirred for a time; and when no more brilliant sparks, which are the indications of the combustion of carbon, are observed, set it to cool, and then weigh it. This, however, is not absolutely accurate, because the dried soil still retains a portion of water in union with the clay, and is disengaged in a red heat, which the combustion of the organic matters requires.

"In order to ascertain the presence of carbonate of lime in a soil, counterpoise upon the scale of a balance, a phial containing some diluted nitric acid. Weigh a quantity of earth to be analysed, and add it to the acid by degrees. If it effervesces, it contains carbonates. Shake it carefully; and having waited a few minutes to let the carbonic acid which is mixed with the air of the phial escape; the phial, with its contents, must be again weighed. If there has been no disengagement of carbonic acid, it is clear that, to restore the equilibrium, it will be sufficient to add to the opposite scale the weight of the earth put into the phial. Whatever is wanting of this weight, represents the precise weight of the carbonic acid disengaged.

"To determine the existence of phosphates and their quantity contained in a soil, first, by calcination, deprive it of all organic matters. Reduce it to a very fine powder; then boil for an hour in three or four times its weight of nitric or hydrochloric acid. Dilute the solution with distilled water, and filter it. The matter remaining on the filter is silica, or alumina, which has escaped the action of the acid. After having reduced the washings by evaporation, and added them to the acid liquor, ammonia in solution is poured in. Taking the simplest instance, the precipitate which falls, upon the addition of this alkali, may contain:—1st, phosphoric acid in union with the peroxide of iron and lime; 2nd, oxide of iron and of manganese; 3rd, silica. This precipitate, which is usually of a gelatinous appearance, is received upon a filter, and well washed and dried, when the precipitate is readily detached from the filter. It is thrown into a platinum capsule, which is raised to a white heat; after which, the weight of the residue is taken. The precipitate, after calcination, is thrown into a small glass mattrass, and dissolved by hot hydrochloric acid. If there is any silica undissolved, its quantity is merely estimated if it is very small; if it be a large quantity, it is to be collected upon a filter, and weighed. To the new acid solution, about three times its weight of alcohol is added. The mixture is shaken, and pure sulphuric acid is then distilled drop by drop, until there is no longer any precipitate. The precipitate is sulphate of lime, which is thrown upon a filter, where it is washed with diluted alcohol. It is then dried, calcined, and the weight of the sulphate of lime obtained permits us to calculate that of the lime, which formed part of the precipitate thrown down by the ammonia in the first instance. 100 of sulphate of lime are equal to 41·5 of pure lime.

"The alcoholic liquor is concentrated in order to expel the spirit. As it is acid, it is saturated with ammonia until a slight precipitate begins to be formed, which is not re-dissolved upon shaking the mixture. A few drops of hydrosulphate of ammonia are then added, upon which the iron and manganese fall in the state of sulphurets. As a part of the metals has been separated, in the shape of oxides, by the ammonia added in the hydrosulphate, it is well to digest for eight or ten hours; because the hydrosulphate of ammonia always ends by changing the metals present into sulphurets, which being washed, dried, and reduced to the state of oxides by calcination, in a platinum capsule, are weighed."

The foregoing directions, if well studied, will enable any person, after a few trials, to conduct an analysis of a soil. With respect to the apparatus required, they are few and inexpensive, and consist of "a pair of scales capable of weighing a quarter of a pound, and that will turn with a grain; a set of weights, from a quarter of a pound troy to a half grain; a wire sieve, coarse enough to admit a mustard-seed through its squares; an Argand lamp, and stand; a few glass bottles and crucibles; porcelain or queen's ware evaporating-basins; a Wedgwood mortar and pestle; filters of blotting-paper, folded so as to contain a pint of liquid, and greased at the edges; a bone knife, and an apparatus for collecting and measuring aëriform fluids."

"The chemical substances or reagents required for separating the constituent parts of a soil are:—muriatic acid (*spirit of salt*); sulphuric acid; pure volatile alkali dissolved in water; solution of prussiate of potash and iron; succinate of ammonia; soap-lye, or solution of potash; solutions of carbonate of ammonia, of muriate of ammonia, of neutral carbonate of potash, and nitrate of ammonia. The soil should be collected in dry weather, and exposed to the atmosphere till it becomes dry to the touch."

"The specific gravity of a soil, or the relation of its weight to that of water, may be ascertained by introducing into a phial, which will contain a known quantity of water, equal volumes of water and soil; and this may easily be done by filling the phial half full of water, and then adding the soil, till the fluid rises to the mouth; the difference between the weight of the soil and that of the water will give the result. Thus, if the bottle contains 400 grains of water, and gains 200 grains when half filled with water and half with soil, the specific gravity of the soil will be 2—that is, it will be twice as heavy as water; and if it gains 165 grains, its specific gravity would be 1·825, water being 1,000. It is of importance that the specific gravity of a soil should be known, as it affords an indication of the quantity of animal and vegetable matter it contains, these substances being always the most abundant in the lighter soils."*

The following is a list of the elementary constituents of the earth generally considered by chemists as simple substances, until by a closer analysis they are proved to the contrary :—

Substances.	Symbols.	Equivalents.	Substances.	Symbols.	Equivalents.
Aluminium	Al.	13·7	Molybdenum	Mo.	46·
Ammonia	Am.	—	Nickel	Ni.	29·6
Antimony	Sb.	129·	Niobium	Nb.	—
Arsenic	As.	75·	Nitrogen	N.	14·
Barium	Ba.	68·5	Norium	No.	—
Beryllium	Be.	4·7	Osmium	Os.	99·6
Bismuth	Bi.	213·	Oxygen	O.	8·
Boron	B.	10·9	Palladium	Pd.	53·3
Bromine	Br.	80·	Pelopium	Pe.	—
Cadmium	Cd.	56·	Phosphorus	Pi.	32·
Calcium	Ca.	20·	Platinum	Pt.	98·7
Carbon	C.	6·	Potassium	II.	39·2
Cerium	Ce.	47·	Rhodium	R.	52·2
Chlorine	Cl.	35·5	Ruthinium	Ru.	52·2
Chromium	Cr.	26·7	Silenium	Se.	39·5
Cobalt	Co.	29·5	Silicon	Si.	21·3
Copper	Cu.	31·7	Silver	Ag.	108·
Didymium	D.	—	Sodium	Na.	23·
Erbium	E.	—	Strontium	Sr.	43·8
Fluorine	Fl.	18·9	Sulphur	S.	16·
Glucinum	Gl.	—	Tantalum	Ta.	184·
Gold	Au.	197·	Tellurium	Te.	64·2
Hydrogen	H.	1·	Terbium	Tb.	—
~~Ilmenium~~	—	—	Thorium	Th.	59·6
Iodine	I.	127·1	Tin	Sb.	59·
Iridium	Ir.	99	Titanium	Ti.	25·
Iron	Fe.	28·	Tungster	We.	95·
Lanthanium	La.	—	Uranium	U.	60·
Lead	Pb.	103·7	Vanadium	V.	68·6
Lithium	Li.	6·5	Yttrium	Y.	—
Magnesium	Mg.	12·2	Zinc	Zn.	32·6
Manganese	Mn.	27·6	Zerconium	Zr.	22·4†
Mercury	Hg.	100·			

Only eighteen or nineteen of the above are found in plants, and those in very

* Davy's "Elements of Agricultural Chemistry," pp. 158—160.

† Morton's "Cyclopædia of Agriculture."

minute quantities, with the exception of the organic or combustible—carbon, hydrogen, nitrogen and oxygen; they are grouped in the following manner:—

1.	2.	3.	4.	5.	6.	7.
Magnesium.	Sodium.	Carbon.	Phosphorus.	Sulphur.	Oxygen.	Chlorine.
Calcium.	Potassium.	Silicon.	Nitrogen.			Iodine.
Manganese.	Ammonium.					Bromine.
Iron.						Fluorine.
Aluminium.						
Hydrogen.						

The others are found in the ashes or incombustible part of the plant. The combinations formed by these constituent elements are of two kinds, mechanical and chemical, the difference between which has been described by Sibson, in his work on agricultural chemistry in the following clear words:—"In a mechanical mixture, each constituent remains unaltered in its essential character, and may generally be recognised in the mixture by the naked eye, or by a microscope, and, in most cases, may be removed from the mixture by mechanical means; and, further, when separated, will be found in the same condition as it was before being added. The appearance and external properties of a mixture are regulated by those of its constituents. On the contrary, in chemical combination, or, as it is called, a compound, one substance at least is essentially altered, and by no amount of examination by the naked eye, or by the microscope, can the constituent particles be detected. Hence the smallest particle is of the same quality as the bulk of the substance, the whole being perfectly uniform and homogeneous. Moreover, the qualities of compounds are not regulated by those of their constituents. Liquids may produce solids; gases may produce liquids; poisons may be formed from innoxious substances; so that no opinion can be formed of the character of a compound by judging of the qualities of its constituents. A few examples will render this more intelligible. When chalk is powdered and mixed with water, a creamy liquid results, possessing qualities intermediate between those of chalk and water. On standing, the chalk settles to the bottom, and the clear water is the same as before the experiment. If instead of chalk we use plaster of Paris, the creamy liquid in this case will quickly harden, and finally become a solid mass; the water will disappear, and no longer be perceptible by the properties it exhibits in a liquid form. In this latter case the materials employed have combined together chemically. Again, gunpowder is a mechanical mixture, although a most intimate one. It consists of charcoal, sulphur, and saltpetre. By washing in water the nitre is dissolved, and now can be easily removed and separated from the other two ingredients by filtering and straining. The nitre may be obtained in a solid form by evaporating, or boiling away the clear liquid over a lamp or fire until it dries up. The two other constituents may also be separated by suitable means not necessary to describe here. Each constituent thus separated from gunpowder will be found in precisely the same condition as regards its chemical character as before being manufactured. But all know that if fire be applied to gunpowder, it is instantly consumed, leaving nothing but a small residue; in other words, its constituents have combined chemically, and how different are the resulting compounds! Except a trace of solid matter, nothing but smoke is seen; yet these compounds, with some invisible gases, contain all the sulphur, charcoal, and nitre that existed in the gunpowder. These materials have assumed new forms in which none of their original properties can be recognised.

"It has been wisely ordered that oxygen and nitrogen in the air shall only be mechanically mixed, not chemically combined. Had it been otherwise, or were they suddenly to combine, the whole face of nature would be altered. The bland health-giving air would be changed into nitric acid, or aqua-fortis. The only essential difference between the air we breathe and aqua-fortis is, that in the air the above gases are simply mixed, in the latter case chemically combined."*

The union of various chemical bodies is not accidental, but is regulated by fixed laws which it is impossible for art to supersede; and it is remarkable that substances of the same family exhibit no disposition to unite chemically, whilst they readily do so with members of an opposite group. Thus, water and oil will not unite; and if by agitation they are mechanically forced into union they separate again as soon as they are left at rest. But water and oil of vitriol unite readily in all proportions; and so strong is this tendency, that if oil of vitriol is exposed to the atmosphere it will increase in weight and volume by the water which it attracts from the atmosphere and combines with. Any oleaginous matter will combine with an alkali, and form soap; but the addition of sulphuric acid to a solution of soap will divest it of the alkali, and leave the oil or fat liberated as before the combination. Ammonia freely combines with sulphuric acid, the produce being sulphate of ammonia. If lime be added, the acid separates from the ammonia and combines with the lime. Such combinations as these are termed single elective affinities. In other cases a double election takes place, in which the acids and bases change positions by natural consent. In the decay of farm-yard manure carbonate of ammonia is formed, and being volatile would escape but for the application of a double affinity in the form of gypsum. This substance is composed of sulphuric acid and lime, whilst carbonate of ammonia is formed of carbonic acid and ammonia. The carbonic acid elects to join the lime, whilst the sulphuric acid prefers the ammonia; and thus the acids and bases both change places, and the sulphate of ammonia, not being volatile, is retained. Such cases of single and double elective affinity are constantly in action in the organism of plants and animals, and meet the farmer in the most ordinary operations of cultivation; but they are not always the consequence of chemical attraction alone, but depend also on accidental circumstances, such as insolubility, volatility, cohesion, and elasticity. The quantity of matter or preponderance of a particular ingredient also exercises an influence beyond that due to simple chemical attraction.†

Generally speaking, the union of substances takes place in definite proportions, causing a fixed and invariable composition for every body. Water, for instance, is composed of eight parts oxygen and one part of hydrogen, and never, under any circumstances, varies therefrom, and so on of other formations; and it is this fixed property of the composition of bodies that give accuracy and certainty to chemical analysis. But the most important law of combination is, that the relative quantities in which bodies unite may be expressed by proportional numbers. These numbers are the *equivalents* given in the preceding tables of elementary bodies. Their great use will be understood

* Sibson's "Agricultural Chemistry," p. 18.

† Morton's "Cyclopædia of Agriculture," p. 442.

if we state the proportional numbers belonging to all the mineral acids and bases found in the organic kingdoms :—

Bases.			Acids.	
Potash	47·20		Carbonic acid	22·00
Soda	31·00		Silicic acid	45·30
Ammonia	17·00		Phosphoric acid	72·00
Lime	28·00		Nitric acid	54·00
Manganese	35·60		Sulphuric acid	40·00
Magnesia	20·20		Hydrochloric acid	36·50
Oxide of iron	36·00	In marine plants	Hydriodic acid	128·10
			Hydrofluoric acid	19·90
			Hydrobromic acid	81·00*

"The above are the only proportions in which those bodies will unite. For instance, if a farmer wishes to make gypsum, he must take twenty-eight parts of lime and forty parts of sulphuric acid. If limestone, twenty-eight parts of lime and twenty-two parts of carbonic acid. These substances will unite in no other proportions, and would therefore be thrown away in any other relations. The laws of combination may therefore be shortly expressed as follows :—

"1st. The composition of all bodies is fixed and invariable.

"2nd. The relative quantities in which bodies unite may be expressed by proportional numbers.

"3rd. When one body, A, unites with another body, B, in two or more proportions, the quantities of the latter united with the same quantity of the former stand in a very simple ratio.

"The term *equivalents* has been given to the lowest proportional numbers in which bodies unite, because these respective numbers are equal or equivalent to each other in combination. Thus, if a farmer wishes to convert limestone first into gypsum, he knows from its composition (twenty-eight parts of lime and twenty-two parts of carbonic acid) that to displace the carbonic acid he must add forty parts of sulphuric acid. If he desire the limestone to be made into nitrate of lime, he must add to the same quantity fifty-four parts of nitric acid. If he use less than these quantities, part of the limestone will remain undecomposed; if he employ more the excess will be wholly useless, and therefore wasted. Hence the knowledge of equivalent numbers becomes important in an economical point of view. A very simple relation is found to hold in gaseous bodies. Gases are found to unite in either equal bulks or volumes, or in multiple volumes. Hence, in combining gases, *volumes* represent *equivalents*.†"

We shall revert again to Baron Liebig's theory, which excited as much interest and surprise amongst scientific men as amongst farmers, although for another reason. As read by the former it ran thus: that in order to produce a crop of wheat nothing more was necessary than to supply the soil with a manure containing, or composed of, the inorganic or mineral constituents of plants. One of the most notable of the opponents of his doctrine was Mr. Lawes, of Rothampsted,‡ who, assisted by Mr. Gilbert, at once

* Morton's "Cyclopædia of Agriculture," p. 442.

† Ibid.

‡ Liebig asserts that Mr. Lawes has entirely mis-stated his views, in proof of which he gives the following quotation from the fourth edition of his work (p. 210):—"Thence it is quite certain that in our fields the amount of nitrogen in the crops is not at all in proportion to the quantity supplied in the manure, that we cannot augment the fertility of our fields by supplying them with manures rich in nitrogen, or with *ammoniacal salts alone*. The crops on a field diminish or

instituted a series of experiments on an extended and continuous scale. The plan they adopted was to divide a field of seventeen acres into a certain number of portions, each being treated in a different manner, and one being cultivated without any manure, in order to exhibit the greater contrast. One portion was manured with the mineral composition recommended by the Baron Liebig, another with that and a portion of ammoniacal salts in addition, and so on. After carrying on their experiments for several years, they deduced the following principles as the result:—

1st. That in order to increase your crops of wheat you must give your plants an artificial supply of ammonia.

2nd. That in order to grow turnips at all you must add a supply of phosphate of lime.*

These propositions were subscribed to by all the most eminent chemists, and they were fully proved to be true by the Rothampsted experiments. The land that was unmanured produced about sixteen bushels of wheat per acre. That manured with only the mineral substances found in plants did not increase the yield beyond the former. But with the addition of ammonia to some of the mineral manure, the produce increased to the extent of from 4½ to 9 bushels of wheat, and from 2 to 5 cwt. of straw per acre. and the effect was still more striking when the ammonia was added in the second year on those parts of the land on which the minerals had been applied the first year without any good result. The large increase proved that the mineral manures never acted at all the first year, nor until brought into action by the ammonia. In order that no evasion should be alleged, Liebig's own patent manure was treated in the same manner, and when applied alone the produce was very insignificant, but when salts of ammonia were added an increase of 14 bushels of wheat and 10 cwt. of straw was the result. These experiments were extended over fifty parcels of land for several years in succession, every crop being tested by weighing the produce. From the result of these experiments Mr. Lawes deduced the collateral principle, that every bushel of wheat, containing in itself one pound of nitrogen, requires five pounds of ammonia for its production, instead of one pound and a quarter, which is its equivalent. Turnips, Mr. Lawes found, want no ammonia for the production of the bulb, but it will largely increase the weight of leaves. The principal mineral required for a turnip crop is phosphate of lime, which he recommends to be applied in a finely divided state, *in addition* to straw-yard manure or rape cake.

According to Mr. Acland, the weight of produce of one acre on a four-course culture, for the whole course, is, in round numbers, about forty tons, of which about four-fifths is water, leaving 17,000 lbs., or about eight tons, of organic matter, and about 1,300 lbs. of inorganic matter, or ashes, which would be left if all the crops were burnt. The organic or combustible parts are carbon, nitrogen, oxygen, and hydrogen. Of these the most important—carbon and nitrogen—are contained in the proportions of 9,000 lbs. of carbon, and about 336 lbs. of nitrogen. The carbon is about equally divided amongst the four crops; the nitrogen in the proportion of 112 lbs. to the cereal, and 224 lbs. to

increase in exact proportion to the diminution or increase of the mineral substances conveyed to it *in the manure*." The learned baron justly complains that Mr. Lawes has, in his work, detached the last sentence of this paragraph, and thus made it appear that Liebig ignores ammonia as an essential ingredient in promoting the growth of wheat. The meaning of the whole paragraph is, "*that ammoniacal salts alone have no effect; that in order to be efficacious they must be accompanied with the mineral constituents; and that the effect is then proportional to the supply—not of ammonia, but of the mineral substances.*"—(See "Principles of Agricultural Chemistry," pp. 54, 55.)

* "Acland's Lectures."

the root and grass crops. In the four years the crops also consumed 100 lbs. of phosphoric acid, or 2 cwt. of phosphate of lime, 3 cwt. of potash, 2 cwt. of lime, and between 2 and 3 cwt. of silica.

The foregoing brief sketch, which is as much as the scope of this work will allow on the subject, does not profess to give a system of agricultural chemistry, but rather by adverting to some of the leading principles of the science, to direct the attention of the reader to its importance, and induce him to make himself acquainted with it more fully by an individual application, and thus to qualify himself to reap advantages from it. It is true not every farmer can, or will, become a chemist; but it is no mean step to be made fully aware, and to be convinced of, the connection between agriculture and chemical science, and of the large benefit it has conferred, and is destined still more to confer, upon those who adopt the principle. The main object of science is, by artificial means, to restore, assist, and increase to the maximum, the productive powers of the soil; for which purpose a knowledge of the principles of animal and vegetable life, so far as they are discoverable, is a necessary preliminary; and this can only be attained by chemical analysis. While this science was unknown, and the history of vegetation was limited to the outward or botanical characteristics of plants, the materials for the pursuit of these objects were exceedingly few. An unreasoning routine in the cultivation of the soil, based upon tradition and experience, without any knowledge of its physiological character, or that of the crop intended to be raised upon it, rendered the practice of husbandry a game of chance rather than of intelligent sequence; and when by the discoveries and experiments of chemical professors new sources of production and compensation to the soil were laid open, it was difficult for the agricultural mind, uninstructed as it was, to grasp the novel theories, or to comprehend the possibility of assisting nature by the application of scientific principles in the economy of the farm.

Nor is this prejudice yet removed or its effects neutralised to the extent we might expect to find them in this country, where the sources of correct information are so free, and so ample. "Agriculture," says Liebig, "is still oppressed by an influence which, without attracting notice, closes the door against all that science teaches. This hurtful influence is displayed by the prescribed rotation of crops. The farmer cannot always cultivate what he ought to cultivate, but is often compelled to occupy a great part of his land with crops the object of which is, by enabling him to keep a number of cattle, frequently both unprofitable and troublesome to him, to produce manure for his corn crops; that is, for the growth of his saleable produce. A large amount of capital in the forms of soil, labour, and money is wasted by these living manufacturers of manure. In our time, one problem worthy the attention of the scientific agriculturist is this, to substitute for the rotation of crops a rotation of proper manures by which he shall be enabled to grow on each of his fields those crops the sale of which, according to his locality and his special object, is the most profitable to him."

At the same time, it must not be forgotten that science itself is yet in its infancy; that there are numerous secrets which nature still refuses to give up, and which, with all the chemical and mechanical aids available, the most indefatigable application has not been able to wrest from her. The deeper the student of nature dives into these mysteries the more clear does it become that there are depths yet more profound to be fathomed, wonders of creation more astounding to be brought to light, and principles more occult to be developed. It is the man of most exalted talent, of most extensive knowledge, of deepest research, who feels the most humbled at the thought that the human mind cannot grasp all the truths, all the principles, on which the great Creator of nature conducts his operations. In science it may truly be said—

> "A little learning is a dangerous thing;
> Drink deep, or taste not the Pierian spring.
> Here little draughts intoxicate the brain,
> But drinking largely sobers us again." *

Yes, the man who knows most is the readiest to confess that he knows little. Sir Isaac Newton, with all his great mind and extensive research, could find no apter similitude with which to compare himself, than that of a child gathering pebbles by the sea-shore. Such, therefore, may well be the conviction of men of humbler talents and less ample means of knowledge; and yet such thoughts, far from discouraging, ought rather to stimulate inquiry. The developments of science are inductive as well as direct; and he who masters one fact or principle, gains thereby a fulcrum on which to plant his lever of research for obtaining further victories. So connected too are the physical sciences, so dovetailed are they one with another (if we may so express it), that the study of one leads almost of necessity to, at least, a general acquaintance with others, by the collateral truths which present themselves.

SECTION VI.

AGRICULTURAL MECHANICS.

The principles of mechanics are few in number and simple in character. They comprise the *lever*, the *wheel and axle*, the *pulley*, the *inclined plane*, the *wedge*, and the *screw*. On one, or on combinations, of these principles are constructed the most complicated as well as the most simple machines and implements that ever have been, or ever will be, invented. They are called *"the mechanical powers,"* because they increase and multiply the momenta of the motive power by which they are acted upon, whether it be animal, water, wind or air, or steam, which are the only powers at present employed in machinery. In the present day, when the use of machinery is increasing in every department of the arts, and machines and implements are multiplying and becoming more complicated in their construction, a knowledge of the principles of mechanics is more than ever a necessity with a farmer, especially if he desires to conduct his business in the most economic, as well as the most efficient manner.

It is a common observation that the practice of science is always in advance of its theory or a knowledge of its principles. This arises from the necessity in which man is placed to procure for himself the means of living; and this he endeavours to do at the smallest possible expense of time and labour. The first wants of man are connected with the fruits of the earth, and the first rudimentary step in the transition from the

* Pope.

savage to the civilized state is the deposit of a seed in the ground for the purpose of providing against a future want. For this purpose the soil must be prepared; to do which an instrument of some kind is necessary. Nature suggests, in the first instance, a pointed stick hardened in the fire, with which to loosen the soil. To this succeeded the spade; and both these simple and primitive implements represent a *mechanical power* —the lever—having the surface of the ground for the fulcrum. It was the same with all the most primitive tools employed in cultivation; and yet the husbandman worked on for ages, without ever suspecting that his laborious employment was conducted on strictly scientific principles. In Ireland and Belgium, where the spade husbandry is still practised to a much greater extent than in England, the implement is made with a much longer and narrower graft, and a handle of the length of five feet and upwards. By this means, having a greater purchase or leverage, they can till the soil to the depth of fourteen inches with as much ease as it can be tilled with a common English spade to that of eight or ten inches.*

The first definition, or scientific explanation, of the principle of the lever is ascribed to Archimedes. It is "an inflexible straight bar," whether of wood or metal, supported at a single point on a fulcrum or prop, and used for raising weights. There are three kinds of levers, having each different forms of service. In one the fulcrum, or centre of motion, is placed between the weight and the power; this is called "the lever of the first kind," and is used to raise stone or other heavy bodies by pressing down one end of the bar with the hand, so as to raise the stone with the other end. The *power* is the force of the hand; the *fulcrum* is the obstacle on which the power rests; and the *weight* is the weight of the stone, &c. A double lever of this kind is represented by scissors, shears, &c., in which the rivet is the *fulcrum*, the hand the *power*, and the cloth, &c., the *weight*. Another is called "the lever of the second kind," in which the weight is placed between the fulcrum and the power. In this case a heavy stone, &c., is raised by lifting one end of the bar with the hand, while the other end rests on the ground under the stone which is raised by the intermediate part of the bar. Here the *fulcrum* is the ground, the *power* is the force exerted by the hand, and the *weight* is the weight of the stone, &c. A double lever of this kind is represented by a pair of nut-crackers, in which the *power* is the force of the hand applied to the handles, the *weight* is the force with which the nut resists crushing, the *fulcrum* is the pin or pivot which connects the two arms or pieces. The "lever of the third kind" is that in which the power acts between the weight and the fulcrum. This is represented by the anatomy of the forearm of a man, when he raises a load with it, turning at the elbow. In this case the elbow is the *fulcrum*; the *power* is the force of the muscles, which, coming from the upper arm, is inserted into the forearm near the elbow; the *weight* is the load raised. The double lever of this kind is the tongs used for holding coals. The *fulcrum* is the pin on which the two parts of the instrument turn; the *power* is the force of the fingers; the *weight* is the pressure exerted by the coal upon the ends of the tongs.

The wheel and axle consist mostly of a cylinder, to which a wheel is firmly united,

* Awkward as this long tool appears, the writer has noticed with admiration the ease with which the Irish peasant handles it, and with what speed he will turn over a large breadth of ground to the above depth in a short space of time, levelling the soil as he proceeds with the back of the spade, and leaving it a deep and finely comminuted seed-bed, for which the extraordinary length and weight of the tool is well adapted.

so that the mathematical axis of both are coincident. The wheel and cylinder are of wood or metal, and the diameter of the former is greater than that of the latter. A cylinder on the circumference, exteriorly, of which are placed boards whose planes, if completed, would pass through the axis, and which (being turned by the force of running water, or by the weight of a man in the act of stepping from one board to another above it) is employed to raise a heavy body by means of a rope passing over a small cylinder on the same axis, is a simple machine of this kind. The same may be said of a hollow cylinder which, with its axle, is made to revolve by men or animals walking in the track of its circumference on its interior surface. The capstan, the windlass, the helm, &c., of a ship, are only so many different forms of the same class of machines. Frequently also the axle is made to carry a wheel with teeth in its circumference,* in order that by its revolving, motion may be communicated to machinery. Such are the wind and water mills employed to grind corn. The mechanical power of the wheel and axle is considered the same as that of the lever of the first kind; for the thickness of the ropes and the inertia of the materials being disregarded, the forces acting perpendicularly to the arm, the effort is the same as if these forces were applied immediately to the extremities of the straight line. The wheel and axle has manifestly, however, a great advantage over the simple lever, since the weight may be raised to any height that is consistent with the length of the ropes.

In toothed wheels the edges of the teeth which act upon one another require to be perfectly smooth, in order to prevent friction. Any defect in this respect causes a resistance to motion, and consequently reduces the force. The intervals of the teeth of the two wheels must be perfectly equal, in order to work into each other; and if one wheel is smaller than the other, the distance must be regulated by the circumference of the wheel, so as exactly to correspond and fit into each other, without a hitch or friction. Wheels are turned either by contact with each other, or by cords, straps, or chains passing over them. In these cases, the unevenness of surface interferes with their perfect action.

"One of the most beautiful illustrations of the action of the wheel and axle is to be found in the main-spring box of the fusee of a watch, round which the chain is coiled. Here the spring-box is the wheel, and the fusee, the axle or pinion to which the chain communicates the motion of the box. The power resides in the spring wound round an axis in the centre of the box, and the weight is applied to the lower circumference of the fusee. As the force of the spring is greatest when it is newly wound up, and gradually decreases as it unwinds itself, it is necessary that the fusee should have different radii, so that the chain may act upon the narrowest part of the fusee, where its force is greatest, and upon the widest part of the fusee, where its force is least, by which arrangement an uniform effect is produced."

The pulley is composed of a wheel with a groove in its circumference to receive a rope, by which it is acted upon. It moves an axis whose extremities rest upon a frame called a *block*. If the pulley is a single one it is hung by a hook to some fixed body; and the rope being passed through, or over the groove, one end is attached to the weight to be raised, whilst to the other end the power is applied for that purpose. A single pulley adds nothing to the power by which it is acted upon, and only changes its direction.

A *system* of pulleys is called a *muffle*, and it is either fixed or movable, according to

* Whewell makes this a *seventh power*, in his "Elements of Mechanics." (See p. 97.)

the nature of the block which contains the pulleys. The "first system of pulleys" is a repetition of the single movable pulley, each one hanging by a separate string. T
weight is attached to the last, or lower, pulley of the series, and the power is applied to the end of the rope that passes over the first or upper pulley. There may be two or more pulleys, but each, from the lowest, is supported by the one next in succession.

The "second system of pulleys" is that in which the same string passes round all the pulleys. It consists of two blocks, or sheaves, an upper and a lower, in each of which are several pulleys, the string or rope passing over the upper and under the lower ones alternately, the weight being attached to the lower block, and the power applied to the rope passing over the last upper pulley.

The "third system of pulleys" is that in which the strings or ropes are all attached to the weight. In this case all the strings or ropes must be parallel, in order to produce regularity and efficiency in the working.

The inclined plane is used in engineering, in which case it is sometimes a strong framework of wood, and at others, masses of earth and masonry. In all cases it is a plane surface supported at any angle with the horizon. It has usually a single or double set of rails or slides, and is, or was formerly, much used for removing boats on canals or rivers, from a high to a lower level, where the scanty flow of water would not admit of the waste of the element incident to a lock. It is still in use in many parts of the United States, in order to get boats over the rapids. In other places it has been found more convenient to cut canals with locks, parallel with the river, and thus avoid the rapids altogether, as on the St. Lawrence, in Canada. The inclined plane, however, is still in use in this country on the Duke of Bridgewater's canal. One of them is 453 feet long, and has a decline of one foot in four, the entire height the boats have to be raised being 106 feet. The boats are conveyed from one portion of the canal to another by means of a windlass. The loaded boat, in descending the plane, turns the axis of the windlass and raises an empty boat. The inclines on railways are on the same principle, but they require the descent to be very gradual; and even where this is attended to, considerable danger exists, if the engineer is not careful to slacken speed in approaching the incline. It is generally supposed that the ancient Egyptians and other Eastern nations raised those enormous masses of stone to the tops of their lofty temples and other structures by means of inclined planes. No other combination of the mechanical powers that the moderns are acquainted with could possibly have effected it.

The wedge is a prism of wood or metal, the base of which is a triangle. It is formed of two inclined planes fastened together at their bases, and is employed to cleave wood or to quarry stone. It is frequently used in machinery, in cases where a great force is to be exerted through a short space. Buildings that have lost their perpendicular position, have had it restored by the wedge; ships are raised by it in dock; and in America houses are raised by it, and a new story built below. In Holland and Belgium it is used in the colza windmills for pressing the rape seed after it has been crushed. The seed is placed in bags of hair, between two flat pieces of hard wood. Between each two pieces of wood a wedge is introduced, and is driven home by a stamper, lifted by the wind-shaft in its revolutions. The planes are thus compressed, and the bags squeezed so hard that the seeds are turned out a hard and solid mass, almost wholly divested of oil. The late Mr. Brunel employed the wedge in cutting veneers, and the plan was an excellent one; but the cabinet-makers foolishly objected to it, because the grain in some instances was separated, and Mr. Brunel was obliged to abandon the plan. All edge tools, as hatchets, adzes, chisels, knives, awls, &c., are different forms of the wedge. The angle for cutting wood should be 30°; iron, from 50° to 60°; and brass, 80° to 90°. The bases, therefore, resolve themselves into either an isosceles, an acute angle, or a triangle. If the power directly applied to the head of the wedge be to the resistance to be overcome by the wedge, as the thickness of the wedge is to its head, then the power will be equivalent to its resistance, and if increased, will overcome it. The wedge is a great mechanical power, and is employed to split rocks, which it effects much easier than any other of the mechanical powers. The force exerted to drive it home, shakes the cohering parts so that they easily split.

The screw is an inclined plane wrapped round a cylinder, or the cylinder itself is furrowed or grooved in a spiral form, and its action, therefore, is that of an inclined plane. The force employed to turn the screw round its axis is considered to be applied horizontally to the base. If the screw and the weight which is to be raised is acting vertically on its inclined surface, the circumference of the cylinder will represent the horizontal length of the screw. But the distance between the threads measured in the direction of the axis, will be its height, provided that the threads be single; consequently the forces required for the equilibrium are to each other as the height of one to the circumference of the screw. But besides these forces, it is necessary that some obstacle should be present which may prevent the body on which the screw acts from following it in its motion round its axis, otherwise there can be no equilibrium. If the furrowed surface be convex, the screw is called a male; if concave, it is female.* The screw is a complex machine, because it cannot be employed without a lever or winch to turn it.

Such are the mechanical powers, an acquaintance with which, and with the general principles of mechanics, is now almost a necessity to the agriculturist. The employment of machinery in husbandry has changed its character, and brought it within the range of skilled art, which it seems destined eventually to become, and to be practised upon purely scientific principles.

A knowledge of the use and application of machinery is by no means difficult to acquire. A machine is but a tool, complicated it may be in its construction, but requiring much less practical skill than many of the ancient implements. The plough itself, which is next to the spade in antiquity and simplicity, is exceedingly difficult to manage by the uninitiated. The accuracy with which a good ploughman will draw a furrow straight to a point, indicated by a piece of stick at a distance possibly of two or three hundred yards, requires much more practical skill and tact than the steam plough, which, when once fixed, works with mathematical exactness without much taxing the ingenuity of the operator, and with less than half the personal labour. The scythe, again, requires a long apprenticeship to handle it with skill and effect; and we have known men advanced in years who never could master its use, so far as to leave a clean level swath. But a mowing machine only requires to be set in motion and kept in a certain direction, to perform its work with the greatest precision and perfectness; and so on of other machines, which, while they relieve the husbandman from the more onerous operations of labour, substitute a more refined and more certain principle of action than that of mere hand labour. The man who can draw a good and straight furrow, or cut a clean

* Whewell.

swath, is a man of one idea only; but he who learns the use of a steam engine, or of a complicated machine, gains a series of ideas which will prepare his mind for the acquisition of other knowledge.

Apart, however, from an acquaintance with the mere working of a machine, which belongs, in a great measure, to the labour-department of the farm, it is necessary for the farmer himself to be acquainted with the principles of mechanics, in order to derive the full benefit from their use. He must know something of the doctrine of forces, or the influence which one body exercises over another, to produce or prevent motion. Thus, a man who turns a grindstone by means of a winch or a treadle, is said to exercise force on the winch, &c., by which the stone is turned. The force exerted to set powerful machines in motion is of various kinds, so far as the agents employed to produce it, such as an animal, water, wind, steam, air, &c., which are the only powers at present used in mechanics. Again; body or matter is the substance that presents resistance to force, excluding other bodies from the space it occupies. The force employed to move a body must be greater than the power of resistance. "Thus, the lever, the wheel and axle, and the pulley, whose properties depend on the theory of parallel forces; when, consequently, of the resistance, the moving power, and the reaction of the machine, some one is equal to the sum of the two others, any convenient portion of the resistance may be made to rest on the point of support or the point of suspension. And in the inclined plane, the wedge, and the screw, the properties depend on the theory of forces concurring in a point; the motive power, the resistance, and the reaction of the machine, are represented by the three sides of a triangle; and the ratio of the first to either of the other two, may be varied at pleasure in the construction of a machine." *

Force implies matter, both in what acts and in what is acted upon; yet force does not necessarily reside in matter, although exercised directly on matter, and through the agency of matter. A heavy body falls to the ground, or exercises pressure by the force of gravitation; "but the force is not inherent, and is a mere attraction, similar in principle of action to that of the magnet on iron." † This is termed an immaterial influence, producing pressure or motion as effectual as by material pressure.

All bodies are capable of motion: a stone falls to the ground, a boat slides down an inclined plane, a bullet is propelled from a rifle, &c. The point in any body to which the moving power is applied, is called the impelled; and that against which the resistance acts, is called the working point. Force may produce either rest or motion in bodies. A single force acting upon a body necessarily produces motion; but two or more forces may be so combined as to counteract each other, and produce rest. Thus, one person pulling at a rope which is free, moves it; but two persons pulling with equal strength at the two ends of the rope, will not produce motion; they will exactly balance each other's effort, and produce rest. In all such cases, forces are said to balance each other, or to be *in equilibrium;* they counteract or destroy each other.

A machine has a certain amount of its force expended on friction, and the inertia of the materials on which it acts; the remainder of the force is the only efficient portion producing useful results. In drawing a body up an inclined plane, the force necessarily

* Whewell.

† Ibid. The Professor has not explained, that while the falling of a body *to the earth* is the attraction of a small body by a larger one, on the principle of *gravitation*, the attraction of iron to the loadstone is exercised *in any direction*, upwards, or downwards, or horizontally, and by a small body on a larger one; and the force *is* inherent in the magnet, but the *principle* on which it acts we are totally ignorant of.

expended in overcoming the resistance of the inertia and the friction is so much deducted from the efficient force of the machine. If a reciprocating motion exists in the same machine, the loss of power by inertia is doubled, because a momentary rest takes place between every two contrary directions of the movement, and immediately after a new inertia is to be overcome. The more complicated it is in its construction, the more are its forces retarded in their action. The more simple, therefore, a machine is in its construction, consistent with the relation between the moving power and the opposing resistance, the better.

These principles of motion and rest have led to the division of mechanics into *statics* and *dynamics*. When two forces exactly counterbalance each other, they produce an *equilibrium*. These are forces "*in equilibrium*," or *statics*. Dynamics relate to forces in motion.

Applied Cinematics treat of the theory of machines simply as modifying motion. For the information of the reader who is desirous of making himself acquainted with the subject of applied mechanics, we refer him to Whewell's "Elements of Mechanics;" "Rankine's Mechanics;" and to an elaborate paper on mechanics in the last edition (1857) of the "Encyclopædia Britannica."

SECTION VII.

HYDRODYNAMICS.

The derivation of this word, which is from two Greek words signifying "water" and "power," explains its meaning; it is the doctrine or science of water-power, whether it acts by pressure, by weight, or by impulse. It is divided into two parts, *Hydrostatics* and *Hydraulics*. The first comprehends the pressure, equilibrium, and cohesion of fluids; the second, their motion, together with the machines in which they are chiefly concerned. In other words, hydrostatics explain the equilibrium of fluids, or the gravitation of fluids at rest; upon removing that equilibrium, motion ensues, and here hydraulics commence. We may illustrate these by the following cases.

Suppose a lake having no outlet, the water is stagnant or at rest, and is consequently in a state of equilibrium, because the resistance to its exit, namely the solid earth by which it is surrounded, is greater than the pressure of the water, and of the atmosphere upon it, which would otherwise cause it to break its bounds and escape. The case of this lake comes under the class of *hydrostatics*. On the other hand, suppose a drain or canal to be cut in the bank of the lake, so as to admit the water to a lower level; motion then ensues, and with it water-power to a greater or lesser extent, according to the quantity of fluid, and the height and abruptness of its fall. This represents *hydraulics*, and the machines employed in the application of this power, are called *hydraulic machines*.

The use and application of this science in agriculture are indisputably requisite, when we come to reflect that an overwhelming portion of the land of England is still undrained, and that the rivers are for the most part in a worse state than that in which nature left them, the water being dammed up by mills, locks, sluices, and other obstructions, by which hundreds of thousands of acres of valuable land are water-logged, and rendered only half-productive of an inferior description of produce. The ignorance of the farmers on the subject of drainage is well described by Talpa,* in the "Chronicles of a Clay Farm;" and although the last twenty or thirty years have thrown great light on the subject, and proved the benefits to be derived from thorough draining, many, of both landlords and tenant farmers, hesitate to incur the expense.

The principle on which hydrodynamics is based, is the tendency of water and other fluids to find their own level; and this is effected by the joint action of the weight of the water itself and that of the atmosphere. We have an illustration of this in the syphon, which is a tube of glass, metal, gutta percha, &c., so bent that one arm shall be longer than the other. The short arm must be inserted into a vessel filled with any liquid, whilst the long arm, resting on the edge, reaches to another empty vessel below it. The syphon being previously filled with the liquid, upon the tap being turned, a continuous stream flows from it, until the upper cask or vessel is exhausted of its contents, or the tap is again turned to prevent the flow. In this case the column of water in the longest arm of the syphon being greater than in the shortest (whether more or less so, is no matter), the additional weight draws, on the one hand, and the weight of air in the upper vessel presses on the surface of the water, on the other, and thus cause the motion.

We have another illustration of the effect of air on fluids, in promoting the flow, in the tapping of a cask of beer or wine. If the cask is quite full, the liquid will not flow through the tap until the air is admitted at the top through a wind-peg hole, after which it flows freely. Take a bottle, again, and fill it with water; place your hand over the mouth and reverse it; then take your hand away, and a struggle instantly commences between the surrounding column of air to take, and the liquid to retain, possession of the bottle. The bubbling that results is the consequence of the mastery of the air over its opponent, which is soon ejected. If a small hole were broken in the bottom of the bottle, no contest would take place, because the air, forcing itself in upon the surface, would add its weight to that of the water to force it out.

There are many farms on which a knowledge of the science of hydraulics might be turned to good account by the occupier. Small streams of water rushing from a high to a low level, are common in most parts of the country, and might be applied to the modern machinery of the farm with excellent effect, and at a comparatively small expense. The most important questions for consideration would be, how to obtain a sufficient fall, and on what principle to apply the power when you have got it. With regard to the last, Sir Robert Kane reduces the water engines to four classes. First, the overshot water-wheel on which the water acts by *weight*. Secondly, the undershot wheel on which it acts by *impulse*. Thirdly, the water-pressure machine, the action of which is indicated by its name; and fourthly, the turbine and "Barker's Mill," which act, the first by a reaction impulse, and the second by reactive pressure.†

It would appear that when the stream of water is small, and a sufficient fall can be obtained, either the overshot wheel or the turbine would be the best modes of applying it. In the construction of the overshot wheel, it requires a thorough knowledge of mechanics to determine the form of the buckets, the quantity of water to let into each,

* Wren Hoskins, Esq. † "Industrial Resources of Ireland."

the point of the circumference at which the water is to be let on, and the exact centring of it, so that its motion may be absolutely uniform. Any fault in these points may be the cause of a partial or entire failure. The fall required is estimated by Sir Robert Kane at from fifteen to fifty feet. In conducting the water to the wheel, it must be so regulated as to act by its weight alone, as impulse would destroy a portion of its power. It should also leave the wheel without velocity, dropping from it at the point where it approaches the race.

Where the fall of water is only a few feet, the undershot wheel is sometimes used; but there is a great loss of power in its application, not more than one-third of its theoretic power being available. The breast-wheel is far superior to it, and is estimated to have 83 per cent. of the theoretic, or 55 per cent. of the calculated, force of the water available. The effect is greatly increased by giving the float-boards a curved form, by which they act more as buckets. Many large breast-wheels have been erected on this principle in France, the power obtained being from 60 to 70 per cent., or an average of two-thirds of the total power of the water. The following summary of the power of the foregoing machines is given by Sir R. Kane, with the height of fall required:—

Wheels.	Economy of Power.	Limits of Head.
Overshot	75 per cent. . . .	15 to 50 feet.
Breast	55 ,, . . .	6 to 15 ,,
Do., curved boards . .	33 ,, . . .	2 to 6 ,,
Undershot	66 ,, . . .	6 to 15 ,,

The water-pressure engine is made nearly on the same principle as a steam-engine, only the valves and passages are larger. Some of these are double-acting engines, and are then similar in construction to the high-pressure steam-engine, only using cold water instead of steam. The fall for this engine, which acts by pressure only, must be great, but a small quantity of water is sufficient to work it. The effective performance is from 60 to 72 per cent. of the theoretic force. At the salt-mines at Salzburg, in Bavaria, the brine is conveyed by a series of these engines for a distance of seven miles over mountains 1,200 feet high, in order to carry on the evaporation in a district where fuel for the purpose is cheap. These machines or engines have been in use in England for some years. Sir R. Kane mentions one erected in Cornwall by Mr. Darlington, which has two cylinders of 50 inches diameter and 10 feet stroke, and is worked by a column of water 30 inches diameter and 44 yards high. Its power is estimated to be equal to 166 horse-power, of which it gives 70 per cent., or 116 horse-power, of practical efficiency. It is seldom, however, that this engine can be applied, except in mountainous districts, where a great fall of a small stream can be obtained.

The turbine is an engine of modern invention, originated by a Frenchman of the name of Fourneyron. "It is a horizontal wheel furnished with curved float-boards, on which the water presses from a cylinder suspended over the wheel, and the base of which is divided by curved partitions, that the water may be directed in issuing, so as to produce upon the curved float-boards of the wheel its greatest effect. The construction of the machine is simple, its parts are not liable to get out of order; and as the action of the water is by pressure, the force is under the most favourable circumstances for being utilised."*

The principal advantages of the turbine are, first, its simplicity of construction just

* Kane's "Industrial Resources of Ireland."

referred to; secondly, a great economy of power united with rapidity of motion; thirdly, whether the flow of water is equal to five or to twenty horse-power, in changing from one to the other by a sudden transition, no disarrangement of the machinery takes place, but the whole of the water is economised, and the working of the machinery adapts itself to the increase or the diminution of the weight or volume of water. Fourthly, the operation of the wheel is not affected by back-water.

Sir R. Kane mentions a turbine erected at Saint Blasien, in France, for driving the machinery of a cotton mill containing 8,000 spindles, with all necessary apparatus. The water is brought two miles by a metal pipe only eighteen inches in diameter; but the height of the fall is 332 feet, and the flow of water one cubic foot per second. The wheel of the turbine is only one foot in diameter, and it makes 2,250 revolutions per minute. Its theoretical force is 38 horse-power, of which nearly three-fourths, or 28 horse-power, is available in practice. The turbines at St. Maur, near Paris, employed in grinding corn, have each a wheel 6 feet in diameter, and paddles 10 inches high; the head of water averages 11 feet 9 inches, and the discharge is 34 cubic feet per second. Each turbine drives ten pairs of mill-stones, with all other requisite machinery, and grinds fifteen tons of corn per day (70 qrs.). The theoretical power of each turbine is equal to 45½ horse-power, and the practical efficiency 33.

It is now, however, admitted that although water-power, where it can be obtained, is the cheapest that can be applied, yet it has the great disadvantage of being subject to such fluctuations in the flow of water, that whilst at one time there is such a redundance as causes half its volume to run by in waste, at another the works are liable to be stopped for want of a supply. Sir R. Kane recommends the construction of reservoirs, of a capacity to hold the winter floods, similar to what have been formed at Greenock; where, from being destitute of water at times for domestic purposes, they have now, in consequence of the engineering skill of Mr. Thom, water enough to supply the town with all that is necessary for the use of the population, and also for working machinery attached to 30 steam engines of 50 horse-power each. The water is brought from a reservoir containing 284,678,550 cubic feet of water, the embankment being 60 feet high from the bottom of the rivulet. Six auxiliary reservoirs are also constructed, which raise the quantity of water to 310,000,000 cubic feet. Thus, through the scientific skill of one man, a whole town has been rendered cleanly, and, consequently, healthy, and employment provided for 7,000 people, earning wages to the amount of £300,000 per annum.*

Although it might not answer for a farmer to go to the expense of forming a reservoir for the catchment of the water in waste, wherever a steam-engine is employed on a farm, if a stream of water can be made available also, the two powers might be made auxiliary to each other without much outlay, whilst water is proved to be by far the cheapest. It is stated that whilst steam at Greenock cost the manufacturers £36 per horse-power, per annum, the water costs only £5 6*s*. 5*d*. per horse-power; where, therefore, a supply of water can be obtained, sufficient to work a mill for grinding cattle-food, or a threshing machine, or any other of the modern fixed machinery of the farm, it could be applied with beneficial effect at a comparatively small expense.

The union of steam with water, in working flour mills, has become very general of late years, in consequence of the decrease of the waters of many of our rivers, occasioned

* Kane's "Industrial Resources of Ireland."

by drainage of land, and a more perfect system of cultivation, by which quicker evaporation is promoted. In these cases the steam is the auxiliary; but in that of the working of agricultural machinery, the employment of water would chiefly be confined to the winter months, which is the period when the machinery is most in requisition. It is probable that mills for grinding beans, oats, and other grain for cattle, will soon be attached to most of the farms of any extent, in the kingdom. Steam will, undoubtedly, be the principal power applied; but wherever a stream of water can be obtained, it would be found, as an auxiliary power, to be both economical in point of expense, and efficient in execution.

But it is in the irrigation and drainage of the land, that the knowledge of hydraulics will prove most generally useful to the farmer; for without it, a regular and efficient system in either operation is scarcely possible. It is remarkable, and not much to the credit of the agricultural interest of England, that whilst the advantages of thorough draining and irrigation were fully understood so early as the sixteenth century, and recommended by several of the old writers of that period, so much land should still remain undrained. Walter Blyth, in his admirable work, after speaking of the injury done to the land by many water mills, which prevent the drainage of the fields on the one hand, by the proprietors claiming a title to all the water, and flood the meadows, on the other, at improper times, and keep them in a boggy state, recommends the destruction of the worst of the mills, and the compelling of the others to lower the gauge of water, in order to facilitate, "first, the flooding or watering all sorts of lands which lie under that capacity; and, second, by *draining* or *reducing* of boggy, fenny, sea, or drowned lands to firmness and fruitfulness." Worledge, too, in a poetical explanation of the frontispiece to his work on agriculture, refers to irrigation in the following quaint lines:—

"In yonder vale, hard by the river stands
A water-engine, which the wind commands,
To fertilize the meads; on th' other side
A Persian wheel is placed, both large and wide,
To th' same intent; there do the fields appear
Cloathed with corn and grain for th' ensuing year;
The pastures stockt with beasts, the downs with sheep," &c. &c.

He describes the Persian, which is an undershot wheel, much employed at that period in Persia, Spain, Italy, and France, in pumping up water for irrigating purposes. In Persia, he says, they had two or three hundred of these wheels on a single stream. He also describes a very simple kind of windmill, consisting of "an axis with vanes like the common windmill. One end of the axis rests on an iron fork on the top of a single post, the other end, movable to several points, on a ridge or ledge in form of a quadrant of a circle, that, be the wind which way it will, by only moving the one end of the axis on the quadrant, it will be direct to the one or the other side of the vanes or sails. Under the end of the axis that rests on the post, let there be a pump placed in the water you intend to raise, the head of the pump not rising much above the passage to convey it away; which pump may be made of what diameter you please, according to the strength of your windmill, and height you raise the water. You may make the trunk of the pump round; or if you would have it large, then square may serve as well as round. Let the bucket always dip into the level of the water; let the handle of the pump (the piston) extend in length to the axis of the wheel, which must be made crooked at the end to receive the same,"* &c. The cost of this machine would be very trifling; and where cheapness is required for want of funds, it might still be employed both in irrigating and in draining a low piece of land, where it is difficult to get off the water.

The necessity for draining wet land was equally understood by this old writer, as well as by Blyth, Hartlib, Gabriel Plattes, and others of the same century. Amongst the "Enemies to Husbandry," Worledge reckons "standing water the greatest inland annoyance, whether occasioned by rains, springs, or otherwise. There are few levels," he says, "but there are places or currents for the water to pass out of them, which you must sink deep and wide enough to drain the whole; and then make several drains from each part of the marsh or level, beginning large and wide at the mouth of the drain, and lessening by degrees as it extends to the extremes of the land you drain. *Be sure to make the drains deep enough to draw the water from under the marsh or bog, and make enough of them, that may lay it thoroughly dry.* . . . Take this as a general observation in agriculture, that most of the barren and unimproved lands in England are so, either because of drought, or want of water or moisture, or that they are poisoned or glutted with too much. Therefore let every husbandman make the best use of that water that runs through his lands, and by preserving what falls upon his lands, as we have, at large, before directed in this treatise and drain or convey away that which superabounds and offends," &c.

It is a humiliating reflection, that in the present day, when science and experiment have thrown so much light on all subjects connected with the cultivation of the land, there should still be so much difference of opinion on the subject of drainage, the advantages of which are so palpable wherever it has been effected. As to the disputes respecting "deep or shallow draining," old Worledge disposes of the question in a few words, "Be sure to make your drains deep enough," &c. &c. To those who neglect draining at all, the next period may perhaps impart some useful hints, if they are not too much wedded to the maxim, "let well alone," to act upon the advice.

In carrying into effect a system of drainage, the first thing to be attended to is to ascertain the lowest point of the field, which must be found by the theodolite; and then to draw the drains with a bearing to that point, regulating them according to the fall of the land. Every step in the operations that follow, involves a knowledge of the principles of hydraulics, and requires a strict attention to the rules of that science. We shall have occasion to go more at large into this practical part of the subject, when that of drainage comes under our notice; but we would earnestly impress upon the agricultural reader the desirableness of acquiring the knowledge necessary to enable him to carry out an intelligent and useful system, without which (as has been found in many cases) the attempt, after much outlay, has proved a failure.

* "Systema Agriculturæ, the Mystery of Agriculture," &c., by J. W., Gentleman, 1675.

SECTION VIII

AGRICULTURAL GEOLOGY.

Geology is one of those modern sciences which in its various bearings and analogies is intimately connected with others of the physical sciences. It may be supposed by some that the subject, which embraces that of mineralogy, is too large and too abstruse to be of practical utility in agriculture, which has more to do with preparing the surface of the earth for the production of food, than with studying its internal structure and composition. This, however, is an erroneous assumption, and it will not be difficult to prove that such a knowledge of the composition of a soil, and of the subsoil on which it is based, lies at the foundation of good husbandry, and that the agriculturist who has taken the pains to acquire it, is the most likely to conduct his business to a successful issue.

We have already shown that soils are composed of the disintegrated materials of rocks, whether in the immediate neighbourhood, or, as in some cases, that lie at a distance, and are brought to their present position by floods. They are divided by geologists into *alluvial* and *diluvial*. An alluvial soil is formed by the deposits of rivers at their mouths, or on other low grounds on their courses; and it consists of the various materials washed from the sides of the stream, or from the lands on either side over which the floods of winter and spring have passed. The very varied character of these deposits causes them to possess great fertility. Mineral, vegetable, and animal substances are all intermingled, the mineral being composed of the *débris* of rocks of every variety of structure, broken up by the action of frost, and other atmospheric phenomena, carried down by the stream, and deposited in a semi-liquid state, forming in time deep beds of alluvium of interminable fertility. The *diluvial* soil is of a different character, consisting of the ancient deposition of various mineral substances, which are spread over a great portion of the earth, and supposed by some to be the vestiges of the Noachian deluge, by which they were brought to their present position, and whence the name. There is, however, sufficient geological evidence of the presence of the ocean over the whole surface of the earth at periods far more remote than the Noachian epoch, and which dates antecedently, and was preparatory to, the creation of man. The deposits referred to are considered to belong to the tertiary series, and are termed by a writer in Morton's "Cyclopædia of Agriculture," "erratic tertiaries, indicating both the nature of the deposit and the period of their formation, namely, that immediately preceding the creation of man." The same writer ascribes them to the gradual subsidence of the land, and a contemporaneous lowering of the temperature towards the close of the tertiary period, by which glaciers and icebergs were formed on the sides of mountains and rocks; and these, assisted by the sea, transported the boulders and other wreck, mixed with finer materials, to the localities where they are now found.

These erratic tertiaries are distributed over a great part of the British Isles in the form of boulders of rock, flint, clay, gravel, sand, &c., varying in thickness from 3 to 300 feet. The lower portion consists of boulder-clay of various sizes, and exhibiting in a scratched surface evidences of their transport by water. In other places, at heights of 600 feet, their deposits are found on summit levels of 6 inches, deepening on the slopes of the valleys, and reaching a thickness of 5 or 6 feet in the plain, merging thus into the alluvium, which it there meets, or nearly so. This is termed "*erratic warp*," and some of it contains land and fresh-water shells, which plainly indicate its aqueous origin. In the paper on the Geology of Norfolk, published in the "Journal of the Royal Agricultural Society of England," in 1849, the following laws on the distribution of soils are laid down :—

"1st. The deposits of the erratic block group indicate in England a long period occupied in their formation upon the terrestrial surface, gradually submerged, and in their denudation during gradual re-elevation, the whole period being characterised by peculiar agencies, which distinguish that of the long series of the secondary and tertiary groups which preceded, and of the modern or alluvial deposits which succeeded and are still in progress.

"2nd. The variations of soils in districts overspread with drift deposits depend upon the amount of their denudation, which has in some instances caused the lower beds of the erratic block group, of different composition from the upper beds, to be the strata nearest the surface.

"3rd. The effects resulting from this cause, have been modified by a deposit hitherto little noticed, which closed the erratic block group, and which has been spread unconformably over the denuded surface of the earlier members of the group.

"4th. This latest deposit, which shades off into the alluvial deposits, varies in depth from less than 6 inches to more than 5 feet, and its depth is dependent on the colour of the surface, which is itself the result of denudation.

"5th. It is frequently found resting on rocks of all ages, without the intervention of any other member of the drift erratic tertiaries.

"6th. Its depth in such cases is equally dependent on contours, which are the result of denudation of those older rocks, effected, in part, during the submergence of the erratic block period, and, in part, during antecedent geological periods.

"These results were obtained by laying down the surface variations of a great part of Norfolk on the Ordnance Map, by means of colours representing the following gradations of soil, according to the presumed proportions of clay which they contained separately by washing :—1st. Blowing sand; 2nd. Good agricultural sand; 3rd. Fine sandy loam; 4th. Coarse sandy loam; 5th. Loam; 6th. Clay loam; 7th. Clay."

The different influence of the older rocks and the erratic tertiary, in producing a soil, is not at present clearly ascertained, but it is probable that both have their influence, and except that the latter lie generally near the surface, and have, therefore, a more direct effect in the formation of a soil, we may conclude that the more mixed a soil is with the *débris* of both formations the more its fertility is secured. In Morton's "Cyclopædia of Agriculture" it is recommended that owners of large estates should employ competent persons to make a geological survey of the property, and have a map constructed of the results, the different soils and subsoils being thereon distinguished by different colours. This would lay the foundation for improvements, by enabling the tenants to apply and mix their materials in the way most adapted to increase or restore the productive powers of the soil. This plan of mapping out the geological characteristics of the country by the government, taking each county separate, with the elevations and sub-strata, in their relation to agriculture, was recommended by Marshall; and Professor Johnstone has followed in the track. The government has adopted the plan, as it respects the general Ordnance Survey, on geological principles, and it only remains for the landed proprietors to follow it up by the survey of their estates.

As the soils are derived from these deposits, so they afford the means of both improving a bad soil and renewing the fertility of an exhausted soil. The light lands of Norfolk were thus rendered fertile by taking the subsoil clay, or marl, and spreading it thickly over the surface. Mr. Cambridge, whose farm,—once a blowing sand,—lies between Downham and Lynn, consisting of 286½ acres, has laid upon it 54,055 loads of clay, or an average of 188 loads per acre; on some of the fields he has laid at the rate of nearly 260 loads of clay per acre. The clay lies immediately under the sand, and pits have been sunk in every field. By such means lands in that county, which formerly would scarcely keep a sheep on an acre, and which produced nothing better than a scanty crop of rye once in three years, now yield the finest wheat in the kingdom, and fatten the largest cattle, and their yearly rent is increased five or six fold, and in some cases more. The clay employed for the purpose is chiefly the *till* of the lower erratics, a mixture of clay and chalk. Marl also is universally used with the best effect, and is sometimes derived from the undisturbed strata of chalk, but more frequently from beds of transported and fragmentary chalk enveloped in the upper erratics; in some cases it is burned for lime, but for the most part it is obtained mixed with a portion of clay or sand, or both, the calcareous matter predominating.

The geological process by which a soil is formed is thus graphically described by Sir R. Kane:—

"The soil is formed by the decomposition of the minerals, of which the crust of the globe consists. The water which flows over the surface is absorbed into the pores and fissures of the rocks; and in winter, on freezing, it expands with such irresistible force as to crumble down even the materials of the hardest and densest stone. The pulverulent or gravelly material so afforded, is carried down by rains or floods to the lower grounds, and, spreading over the more level country, forms the cultivable soil. Independent of the mechanical action of water, the constitution of numerous rocks is such as to cause their gradual decomposition by its chemical action, as in the case of felspar and other minerals; and by the direct action of the atmosphere all rocks which contain protoxide of iron very rapidly decompose and crumble down. Such being the origin of the soil, its constitution will be easily understood to depend on that of the rock from which it has been formed; and as on this constitution its fertility, or its power of supplying plants with the materials they require for their growth, mainly depends, it will be seen that the agricultural capabilities of a country are immediately connected with, and dependent on, its geological character. A district of which the rock is simple in constitution cannot furnish a fertile soil. A pure quartz rock, or a pure limestone, could only furnish from its soil to plants, lime or silica, and they should hence languish for want of other equally important elements. The edges of a geological district, where various rocks are in contact, will therefore always be more fertile than its interior; and the more numerous are the rocks in the neighbourhood, and the greater the diversity in their mineral character, the more complex will be the soil furnished by their decomposition; and by its power of furnishing the elements of growth to different kinds of plants, the greater will be its energy and range of fertility."*

* "Industrial Resources of Ireland," p. 248.

When, therefore, it is considered that all soils are composed of the detritus of rocks, and that these rocks represent different epochs of the natural history of the ancient world, and that many of them contain the organic remains of extinct, as well as of living species of plants and animals, which peculiarly fit them for the formation of soils, it will at once be admitted that geology—which treats of the nature of rocks, and which separates and classifies them according to the periods in which, it is assumed, they were thrown by the convulsions of the earth into their present forms—has a direct bearing upon agriculture, in connection with the formation and constitution of soils.

Geology is defined by Professor Phillips as "that science to which is allotted to investigate the ancient natural history of the earth; to determine by observation what phenomena of living beings, or inorganic matter, were formerly occasioned on or within the globe, in what order and under what conditions; and, from comparative data, furnished by investigation of the present operations of nature, to infer the general system of successive revolutions which the earth has undergone, before arriving at its present state; and thus, finally, to furnish a complete view of the conditions which have regulated, and of those which do regulate, its system of mechanical, chemical, and vital phenomena."

We give the above definition of the learned Professor in order to show the reader the wideness of the subject, rather than with the design of following it in all its bearings. Our business is to explain its connection with the cultivation of the soil, and the benefits that the agriculturist may derive from it, by applying the knowledge he may acquire in the management of his land. We therefore propose to give a statement of the general outlines of the science, according to the system drawn up by the most eminent geologists of the present day.

In the working of mines and other subterranean employments it has for many ages been observed by those engaged in them, that the crust of the globe is composed of various layers, or strata, of different kinds of earthy or rocky substances, some of great and others of less thickness; and that wherever these have been penetrated to their greatest depth, they have in every instance, and in every part of the world, been found resting on the same granitic basis, which in no case, we believe, has been penetrated to its whole extent downward. From thence geologists have almost universally considered granite as the primitive rock, resting upon its original bed, and undisturbed except by those internal convulsions which have upheaved the surface. The origin of granite is ascribed to fire in the centre of the globe, to which opinion its crystallised form has given rise.

The materials of which the earth's crust is composed have been reduced by geologists into three classes, distinguished by the names of *Primary*, *Secondary*, and *Tertiary* formations. Each of these are considered to represent a distinct and separate period, of unknown duration, but marking by no unequivocal signs the several stages or gradations by which the globe has emerged from the chaos of primeval nature to that state in which it has become fitted for the abode of man. These periods are distinguished by the vestiges of a graduated scale of organisms, commencing in the primary formations with the lowest forms, and few in number, of animal life, and gradually ascending, until, in the surface or *diluvial* covering, the remains of animals and plants analogous to those now existing are discovered in a greater or less degree of fossilisation, according to the time that has elapsed since their depositio ·.

Attempts have been made by foreign *savans* to calculate the number of years that must have passed to effect each of the changes indicated by the several formations, and the phenomena attending them. But it is evident that such calculations must be not only hypothetical in the extreme, but approaching to absurdity; for so ignorant are we of the rapidity or slowness of the processes by which certain of nature's effects are produced, that any figures we give to represent them must be offered at random; and in allowing 30,000 years for the formation of certain deposits, we may with as much propriety extend it to ten times that period, or reduce it to one-tenth. We believe the English geologists have all abandoned the idea, considering it one of those inscrutable subjects known, and only possible to be known, by the Great Creator, at whose command the globe itself started into existence.

The following are the principal substances contained in the crust of the globe:—

Primary formations	Granite as the base, with its associated Stratified Rocks.	
	Basalt and Volcanic Rocks.	
Secondary formations	Clay Slate.	
	Graywacke.	
	Silurian formation.	
	Old Red Sandstone.	
	Mountain Limestone	Carboniferous or Coal formations.
	Millstone Grit	
	Coal Measures	
	Sandstone and Clay	
	Magnesian Limestone	New Red Sandstone formations.
	Variegated Sandstone	
	Blue Lias	Oolitic formations.
	Lower Oolite and Oolitic Sand	
	Great Oolite and Fuller's Earth	
	Cornbrash and Forest Marble	
	Coral Rag, Calcareous Grit, and Oxford Clay	
	Portland Lime and	
	Kimmeridge Clay	
	Wealdon Group	
	Green Sand and Gault	Cretaceous formations.
	Chalk	
Tertiary formations	Plastic Clay.	
	London Clay.	
	Crag and Bagshot Sand.	
Recent formations	Diluvium or Drift.	
	Peat.	
	Alluvium.	

The disturbed shell, or crust, of the earth has been penetrated to the depth of about nine and a half miles; below that are the granitic bed and layers of lava and slate, on which the Primary strata rest, and in which no organic remains of any description whatever have been discovered. The Primary formation resting on the granite occupies about 33,000 feet in depth, and contains the remains, in a fossilised state, of animals of the lowest forms of life, such as *molluscs* (soft), *crustaceans, zoophytes, corals,* &c. The series of rocks enclosing these fossils is termed the *Palæozoic* (containing the animals of the olden times), and geologists have separated it into five groups, namely, the

Cambrian (which is the lowest), the Silurian, the Devonian, the Carboniferous, and the Permian. Although these are considered to rest upon the granite, and mostly to have been derived from it, the granite in many places rises above all the formations in rocks of considerable elevation, as in Ireland, for instance, where such rocks form one of the most distinguishing features of the country. Thus, one granitic district reaches from near Dublin to New Ross in Wexford, a distance of nearly seventy miles; and the entire northern coast of the Bay of Galway is composed of granite rock. The Cambrian forms the lowest group of fossiliferous rocks, and contains no other vestiges of animal organization than one or two species of zoophytes, and a few sea worms.

The Silurian period, which is the next in order to the Cambrian, is divided into upper and lower, consisting of sandstone, limestone, and shale. It contains a considerable number of marine animals, as those of the crab family, star-fish, sea-urchins, and *molluscs* of every sort, but no terrestrial animals or plants have as yet been discovered, nor even marine animals of the higher forms. On the other hand, between 700 and 800 species of molluscs have been identified in the Silurian rocks, 200 species of crustaceæ, varying from the size of a fly to twenty inches in length, and 110 species of zoophytes. All these fossils are common to the whole series of the Silurian rocks, but both the upper and lower are distinguished by characteristic fossils, the lower containing *Trilobites, Graptolites,* and *Stonelilies;* the upper group, *Terebratula, Pterygotus,* and five specimens of corals. The first of these is a species of mollusc; the second is a crustacean of the lobster kind, some of which have been found eight feet in length. The coral insect and its production are well known. The corallines of the Silurian group are numerous, and some of these have beautiful forms, but the greater number are of the commonest description.

The Devonian period is termed the "age of fishes," because that higher form of animal life first made its appearance in it. It is composed chiefly of red sandstone, and takes its name from the prevalence of that substance in Devonshire. Its average thickness of strata is estimated at about 9,000 feet. About 800 species of the fossils belonging to the Silurian groups have merged into the Devonian of a much larger size, and some of them of a higher conformation; but they give place, both in numbers and in class of organism, to the fossil fish, with which the whole of the Devonian strata swarm. None of the species, however, or even the genera, are similar to those now existing, with two or three exceptions. There are two important respects in which they differ: first, fishes of the present period have skeletons of bone, whilst those of the Devonian period have a cartilaginous skeleton. Again, the present fishes have tails with equal lobes in form of a U, but those of the Devonian strata have the tail either pointed or conical, and shaped like a V.

Besides the fish, this group contains a few reptiles of the newt and lizard species, and marine plants, mosses, ferns, and trees of the conifera tribe. Of these the seaweeds are by far the most numerous. The rocks in which these latter forms of organic life are found are called "transition rocks."

The Carboniferous period is so called because it contains the beds of coal from which the fuel now universally used is taken. Alternating with this substance are found limestone, shale, ironstone, clays, &c. The appearance of this mineral (coal) indicates a further advance in the creation of organic life, it being in its own substance the production of masses of vegetables—ferns, mosses, seaweed, and larger plants, swept together by the force of floods into hollow cavities of the globe, covered over with earth, and petrified or fossilised by being pressed down and excluded from the air. 850 species of plants have been discovered in coal, of which 250 species are those of gigantic ferns, some of them of the most beautiful forms. Most of the plants discovered are supposed to have been flowerless and fruitless; at least neither flowers nor fruits have been discovered upon or with them, and not more than twenty single and 100 double seed-leaf plants have been found. "The finest example I have ever witnessed," says Buckland, "is that of the coal mines of Bohemia. The most elaborate imitation of living foliage upon the painted ceilings of Italian palaces bears no comparison with the beauteous profusion of extinct vegetable forms with which the galleries of these instructive coal-mines are overhung. The roof is covered as with a canopy of gorgeous tapestry, enriched with festoons of most graceful foliage, flung in wild irregular profusion over every portion of its surface. The effect is heightened by the contrast of the coal-black colour of these vegetables, with the light groundwork of the rock to which they are attached. The spectator feels himself transported as if by enchantment into the forests of another world. He beholds trees of forms and characters now unknown upon the surface of the earth, preserved to his senses, almost in the vigour and beauty of their primeval life; their scaly stems and bending branches, with their delicate apparatus of foliage on all, spread forth before him little impared by the lapse of countless ages, and bearing faithful records of extinct systems of vegetation, which begun and terminated in times of which these relics are the infallible historians." The *Sigellaria*, or seal-trees, found in these, and also in the Newcastle mines, are a beautiful tribe of plants, having singular impressions like seals, in regular order, upon their trunks. The number of animals found in the coal formation is very small, and those are chiefly aquatic or amphibious, and of the crocodile species. Zoophytes and molluscs are found in the lower strata, but do not exist in the coal itself.

The Permian strata consist of magnesian limestone, and terminate the *Palæozoic* system, forming the base of the Secondary. The fossils of this period do not differ much from that of the carboniferous, and the coal, in fact, frequently crops out through it, owing probably to volcanic disturbance. The first specimens of fish *with fins and gills*, and the *Protosaurs*, or first types, of small size, of the *Saurian* family are discovered in this formation. The limestone is used in building, and was employed in the construction of the new Houses of Parliament—to the disgrace of the builder, as it is already in a state of decay, and will have to be replaced at enormous expense.

The *Secondary* period is the "age of reptiles," and is divided into four groups, namely, the Triassic, the Oolitic, the Wealdon, and the Cretaceous.

The Triassic (triple or threefold) or Saliferous group consists of marl, limestone, and sandstone formations. It also contains rock-salt. The fossils are those of a higher order of animals, and the footprints of animals resembling those of a man's hand are found in the sandstone of this group, indicating the existence of a monster, whose fossil skeleton has been discovered. It is called a frog-lizard, or labyrinthodon, and is of the salamander tribe. The various saurians are also numerous here, but no land animals of any kind have yet been discovered in this group, although the footprints of birds have been found on sandstone and shale, not webbed, but apparently of the gallinaceous species. Of the *Ichthyosaur* family twelve species have been found varying in size from 30 to 50 feet, with a mouth 7 feet wide, and teeth like the crocodile; the sockets of its eyes were 18 inches in diameter; it had four paddles or fins, the fore ones being long and containing 100 bones; the hinder much shorter. It must have possessed immense strength, preying upon fish, molluscs, and reptiles, as indicated by its teeth.

The *Plesiosaurus* (akin to a lizard) was also a carnivorous reptile, of which twenty species have been discovered. The long-headed species was 18 feet in length, of which 8 were comprised in its neck; the girth of its body was 7 feet, and it resembled that of a fish, whilst its back and tail were those of a quadruped. It frequented the estuaries and shallow parts of the sea, where it preyed on fish. Like the turtle and crocodile, it moved slowly on land.

Beds of rock salt occur under the new red sandstone, from which brine-springs issue in great numbers. Rock salt is found in all marine deposits, and is supposed to be of volcanic origin, chloride of sodium being one of the substances thrown up by volcanoes; but it is a question whether this may not have arisen from a bed of that mineral having lain over the source of the eruption, or within its range. Nothing decisive, however, can be alleged upon the subject, either one way or the other.

The Oolitic and Lias formations conduct us another step in advance of organic life, in which the reptile tribes, and the molluscs increase in numbers and in species, the ammonites and belemnites first making their appearance in it. The fishes also alter in their structure. The crustaceans become larger, and the first indications of mammalia are seen. The most extraordinary fossil of this formation is the *Pterodactyl*, or flying dragon, which is a compound of bird, bat, and crocodile. A great many varieties of this reptile have been found, the wings of which measure from 5 to 25 feet. These are attached to the arms like those of a bat. Its neck and chest were those of a bird, its body and tail resembled those of a quadruped, whilst its head was sometimes a mixture of the bird and the reptile, in some species the jaws being armed with long pointed teeth, in others the mouth had no teeth, and resembled the beak of a bird. Its eyes were enormously large to enable it to see in the dark; the claws had five toes, and the outer one of the fore-arm was long, and strong enough to support the wing in its flight; from the last faculty it takes its name, which signifies "*wing-finger.*"

The mammalia of the Oolite consists of an extinct species of kangaroo, which are considered in respect to their conformation the most inferior of the family, and but little in advance of birds in organization. An opossum also has been found; but both of these were very defective in their make compared with even the race of those animals now in existence. The most remarkable plants of the Oolite were the *Cycadea*—an order between the fir and the palm—and tree-ferns. The first were a beautiful class with tall, straight stems, bearing at the top an umbrageous head of splendid foliage. A few sea-weeds complete the list of the vegetable fossils.

The Oolite is succeeded by the Weald,* which consists of a thin stratum, the only deposit from fresh water in the secondary rocks, consequently its organic remains are chiefly those of fresh-water plants, shells, fishes, and reptiles. The vegetables are mostly of a tropical character; the animal fossils are those of the bones of crocodiles, turtles, reptiles, birds, and fresh-water fishes. Megalosaurs, pterodactyls, and other Oolitic animals, with some new species, as the iguanodons and hylæosaurs, are also found in the Weald. The latter were land crocodiles, living in the forests; they were about 25 feet in length, with limbs much longer than those of the crocodile, fitted to walk with ease on dry land.

* It takes its name from the wealds or wolds of Kent, where it was first noticed.

The iguanodon was of a genus of Saurians or crocodiles; its appearance must have been formidable, its length being from 40 to 80 feet, its girth from 20 to 40 feet, and its body covered with thick scales; its legs were longer in proportion than those of the crocodile, and the thigh bone was larger than that of the elephant. It resided near rivers, and lived upon vegetables and insects.

The chalk formation succeeds the Weald, and is in all cases a deposit from the ocean. It crowns the Secondary series, and is the base on which rests the Tertiary. It is divided into three sections, the lowest being a mixture of chalk and sand, the middle one of chalk and clay, and the upper pure chalk; chalk, in fact, is a conglomerate of corals, shells, and sea plants granulated, decomposed, and condensed into its present form by the pressure of the super-incumbent strata. It contains considerable quantities of flints, which are formed by a chemical combination of particles of the shells of microscopic animals, which, with a good microscope, may sometimes be discerned in the flint, and even the skeletons of animalculæ.

The fossils of the chalk formation are very numerous, more especially those of molluscs, zoophytes, crustaceæ, infusoria, &c. The Saurian family are represented by only one species, the mosa-saur, and both fishes and reptiles are rarely met with. In the chalk formation of America there are found two gigantic sword-fish—one having the *teeth* of a crocodile, called the *saurodon*, or lizard-toothed; the other the *head* of a crocodile called the *saurocephalus*, or lizard-headed.

The *Tertiary* formation lies between the upper crust of the globe and the chalk. Sir Charles Lyell has divided the whole into four series or groups, the lowest of which he calls the *Eocene*, the next the *Miocene*, the third the *Pliocene*, and the upper the *Pleistocene* periods. These names were given by him according to the proportion of existing species of shells found in them. Thus, out of 1,238 shells found in the lowest group only forty-two belong to those now existing, being only 3½ per cent. The next contains 18 per cent.; the third between 40 and 50 per cent.; and the upper 90 per cent., with the addition of the fossil remains of bears, badgers, hyenas, wolves, dogs, foxes, cats, moles, oxen, deer, camels, horses, in fact, every genus of existing animals, except those of the human species, not one specimen of which, or even a small portion, has been yet found in any of the series below the upper surface crust, of which we shall presently speak. The fossils of the Tertiary period are indicative of an entire change in the natural productions of the earth, by the destruction of the former and the creation of a new and higher grade of animals, and a greater number of species.

The *Eocene* group contains, besides the forty-two shells belonging to the present period, fifty species of mammalia according to Cuvier, four-fifths of which were thick skinned. The most remarkable of these are the tapirs (*palæother*), the armadilloes (*glyptodon*), the deer (*anoplother*), hippopotami, or chœropotami, and herbaceous whales. Of the tapirs there were twelve species, varying in size from that of a hare to an elephant. Like the present tapir, they lived in the woods and fed on herbage. The fossil armadillo was as large as an ox, and was invested with a solid coat of mail, in which it could roll itself up into a ball, presenting an impenetrable surface to the enemy. The *anoplother* was a mixture of the rhinoceros, hippopotamus, camel, and horse; like man and the monkey tribe, it had forty-four teeth. It is the first animal we meet with that had a parted hoof. It fed on shore, but was amphibious. The *chæropotamus*, or river-hog, was about the size of an ass, was thick skinned, fed on herbage, and amphibious.

The *zeuglodon* (or yoke tooth) is now considered to be a whale. Its tail was 100 feet in length, and it lived entirely on herbs, having only molar teeth.

The *Miocene* period presents but few phenomena different from the preceding, except in the greater number of existing plants and animals, and in the appearance of such land animals as bears, hogs, dogs, horses, and cats, and such marine animals as seals, dolphins, walruses, and whales. The *dinother*, however, was an amphibious beast, between the elephant and the hippopotamus, having the proboscis of the former and the tusks, curving downward from the lower jaw, of the hippopotamus. It lived on vegetable food, which it is supposed to have dug up from the bottom of the sea. It was 20 feet in length.

The *Pliocene* period, with a still larger assortment of existing species of shells, exhibits also many new land animals of extraordinary size and form, as the mastodon, the mammoth, the megatherium, the mylodon, the megalonyx, the taxodon, and the giant tortoise 18 feet in length. The *mastodon* was somewhat like the elephant, but larger and heavier. In its early stage of existence it had tusks in the lower jaw, but the female shed them both, and the male, one, as they grew up. It fed wholly on vegetables. The *mammoth* is an extinct species of elephant, 9 feet high, and from 16 to 18 feet in length. The tusks were 9 feet long, and curved almost so as to form a circle, from the upper jaw. It had three kinds of hair, one lying close to the skin like wool, another soft and flexible but longer, a third sort about a foot long and as stiff as bristles. One of these extinct animals was discovered by a Tungusian fisherman in a mass of ice. After remaining there probably thousands of years, when freed from its prison, in which doubtless it was immured alive, it was found in as perfect a state as when living, even to the eye-balls, which were as glassy as if just slain. The wild dogs and wolves devoured the flesh, but the skin and such of the hair and skeleton as could be collected were taken to St. Petersburg, where they are placed in the museum of natural history. The mammoth had the feet, trunk, and general form of the elephant, but its teeth were different.

The *megatherium* has a body 14 feet in length, but is chiefly remarkable for the enormous size of its limbs, its thigh bones being thrice as large as those of the elephant, its haunch bone twice the breadth, and its feet a yard long. Its head was small, and like that of the sloth, but it had enormous strength in its jaws, which were adapted for crushing and masticating the roots and branches of trees. It had only molar teeth, a short neck, feet furnished with gigantic claws, a long tail, and a hide covered with a horny coat of mail of great thickness. Grubbing away the earth from the roots of trees, and then raising itself on its haunches and tail, with its fore paws it wrenched the tree from the earth, and made its meal on the roots and branches. The *mylodon* (having teeth like millstones) and the *megalonyx* (or great-clawed) are both of the same genus as the megatherium, the first being as noted for largeness of structure, strength of jaw, and absence of canine teeth; the second was one-third smaller, had no front teeth, and the bones of the claws were enormously large and of great strength. The *taxodon* (or bow-toothed) had a thick skin, and its teeth were curved. It was a mixture of the squirrel, deer, and whale, having a skull 28 inches in length, and 16 in breadth.

The *Pleistocene* (or most recent) group is the highest of the Tertiary formation, in which are found the remains of the greatest number of specimens of birds, beasts, fishes, and reptiles, in a fossil state, analogous to most of the existing species, such as *glyptodons* (gigantic armadilloes), stags with horns three yards asunder from tip to tip, bisons as large as elephants, rhinoceroses, whales, walruses,* &c., &c.

Immediately above these formations there is a deposit termed by geologists the *Drift*, which consists of the fragmentary parts of rocks separated from the main portion by violence, and driven by the force of water over the dry land. Upheaved by internal fire, the strata of the different formations have been forced out of their horizontal position into others, forming various angles (called *dips*) with the horizon. The consequence is, that the strata of the different periods have become intermingled and broken, lying in every possible direction, and presenting, when examined downwards, a mixture of all the formations commingled. Fragmentary portions of greater or less magnitude broken off from these rocks have been scattered about, and by the force of inundations driven forward, leaving in their course evident tokens of their presence and passage over the surface. The *detritus* chafed from them and left in their course is called the *drift*, and the larger portions remaining after the inundation had subsided are termed *boulders*. They consist chiefly of granite, as the least destructible, the softer portions of rocks having become decomposed, and mingled in the drift. No vestiges of human bones have yet been discovered in the drift, but spear and arrow-heads of stone are occasionally found. But unaccompanied as these are with any other human remains, it is still uncertain whether they can be taken as proofs of the contemporaneous existence of man with the other species of fossil animals found in the drift, or whether their presence was accidental, the effect of a convulsion, or, finally, whether they are, as some believe, natural productions of stone, taking this particular form.

Another deposit, partially overlying the previous formations, is produced by the constant action of rivers, in bringing down the sedimentary materials washed from their sides, and deposited by overflows either on the lands adjacent to the banks, or carried down to their embouchures, where they extend the land and form deltas.† These deposits are called *alluvial* or *diluvial*, and they frequently cover extensive tracts of country. The delta of the Nile is formed entirely of such deposits, and is 150 miles in extent. That of the Mississippi is equal in extent; and this is common to all the great rivers, both of the old and new world. The Mississippi is said to carry down a cubic mile of sediment every five years; and the Ganges to bring down earthy matter enough annually to form a building equal to the largest pyramid, without sensibly diminishing the depth of the Bay of Bengal, into which it is thrown.

Lastly, above all the foregoing deposits, is the upper soil of the crust, occupying about 200 feet in depth, and containing the relics of the last creation, including those of the human species. The soil of this deposit is mingled with the organic remains of plants and animals, the elements of which constitute its fertility, according to the greater or less extent of their presence. The importance of these to agriculture will be felt when the process of their decomposition and its effects are considered. "After the death of a plant," says Kane, "its elements, yielding to the force of their chemical affinities, enter into new arrangements; and by a series of progressive alterations are finally converted into a dark brown material, properly termed *vegetable mould*, and by

* The foregoing account of the fossil kingdom is chiefly taken from Brewer's "Theology in Science," a valuable elementary work on the subject.

† Delta, the Greek letter Δ, a term applied to an alluvial tract of country between the diverging mouths of a river, often subject to inundation. See "Webster's Dictionary."

chemists 'humus' or 'ulmine.' This substance, however, of itself is destitute of power on vegetation; but when vegetable matter commences to decompose, it evolves carbonic acid, and absorbs oxygen from the air; but not only does it unite with that element, but also the nitrogen of the air is absorbed in considerable quantities, and enters into the composition of the new product, which actually acquires thus almost the composition of an animal substance, and is called by Hermann *nitrolin.* The composition of this body, as compared with animal flesh, is as follows:—

	Nitrogen.	Flesh.
Carbon	57·20	55·20
Hydrogen	6·32	7·00
Nitrogen	12·20	16·00
Oxygen	24·28	21·80
	100·00	100 00

If the nitrolin remain in contact with air and moisture, it falls into decomposition precisely as animal bodies do. . . . . It is by the gradual formation and decomposition of this substance that the organic matter of the soil becomes so powerful an agent in its fertilisation. The roots and fibres of a crop left in the soil gradually rot, and become thereby the means of absorbing from the atmosphere a quantity of nitrogen, which is rendered available for the sustenance of the next generation of plants." *

The number of liquid, aerial, and solid compounds at present recognised belonging to this globe is fifty-four, termed simple or primitive, because in the present state of geological science they appear incapable of further decomposition. Forty-three are metallic bodies, brilliant, electro-positive, and, with the exception of sodium and potassium, heavier than water. Of these thirteen produce by union with oxygen the earths and alkalies:—

Aluminium.	Thorium.	Lithium.
Glucinium.	Zerconium.	Sodium.
Magnesium.	Yttrium.	Potassium.
Barium.	Calcium.	
Silicium.	Strontium.	

Five decompose water at a red heat:—

Manganese. Zinc. Iron. Tin. Cadmium.

Twenty-four do not decompose water at any heat, the more oxidable of which are:—

Arsenic.	Antimony.	Copper.
Molybdena.	Uranium.	Tellurium.
Chrome.	Cerium.	Nickel.
Vanadium.	Cobalt.	Lead.
Tungstar.	Telanium.	Osmium.
Columbium.	Bismuth.	Mercury.

The less oxidable are:—

Silver.	Rhodium.	Gold.
Palladium.	Platinum.	Iridium.

Eight are non-metallic combustibles:—

Sulphur.	Iodine.	Carbon.
Phosphorus.	Bromine.	Fluorine.
Silenium.	Boron.	

* Kane's "Industrial Resources of Ireland," p. 255.

Many of these are exceedingly rare, and the number of useful combinations into which they enter is reducible to ten, according to Phillips. The researches, therefore, of the agricultural geologist should be specially directed to the study of the limestone, sandstone, and clay deposits, as more intimately connected with the composition of soils, and consequently the most interesting objects of geology to the agricultural student of that science.

The stratification of the materials of the earth's crust is clearly defined, and without confusion of substances. In one range of country, for instance, a chalk formation prevails, as that of the Yorkshire wolds, which extends through part of Lincolnshire, Norfolk, Suffolk, Bedfordshire, Wiltshire, Dorsetshire, &c. The oolitic limestone, commencing in Lincolnshire, passes through Northamptonshire, Gloucestershire, Somersetshire, &c. The coal formations occupy the northern and western counties; whilst the granite is confined chiefly to the mountainous districts of the kingdom, as in Wales, Scotland, and Ireland (above referred to). The same principle of stratification also prevails universally, and in every country various rocks are found overlying one another in a certain settled order of succession. Thus the strata of North America, New Holland, and Europe are found in many important particulars to be analogous.

Rocks are either *stratified* or *unstratified*. The former are mostly termed metamorphic, and are aggregates of different earths, as sandstones, clays, and limestones. These rocks, by their disintegration, are the best fitted to form soils; and, accordingly, where they abound, we find the country fertile. Such is the case with many of the best lands of Ireland, the soils of which are formed of the detritus of highly stratified rocks. The unstratified rocks consist generally of crystallised masses, mostly of volcanic origin. While the stratified rocks have undergone the action of water, and contain the remains of plants and animals which perished by the same aqueous convulsion or inundation by which the deposit of the strata was formed, the unstratified appear to have been thrown up in a state of fusion by a more violent internal convulsion, as by volcano, which opinion is further confirmed by their enclosing no organic remains whatever to prove them of an aqueous origin. "These two divisions of the substance of the crust of the globe, deriving their origin from distinct causes,—fire and water, the one is termed by geologists *Plutonic* or volcanic, the other *Neptunian* or aqueous. The study of the former belongs to mineralogy, that of the latter requires the aid of botany and zoology."*

Strata are divided into *chemical* and *mechanical*. The chemical deposits are limestone, composed of carbonate of lime and magnesia; and salt rocks, characterised by muriate of soda. The mechanical strata are composed of earthy substances, and are distinguished by the coarseness or fineness of the materials, and their natural qualities. When mixed, fine and coarse in one mass, they are termed "conglomerate." Smaller pieces constitute sandstone, and any fine particles clay. Gneiss, granite, quartz, felspar, and mica have a common origin, and are considered the oldest strata. Sandstone is an aggregate of small fragments of quartz, with or without a mixture of argillaceous, calcareous, or ferruginous cement in the interstices, and with or without mica in the partings. It is supposed that sandstone, like gneiss, derives its origin from granite. (Phillips.) Their dispersion with that of clay was effected rapidly by the agency of inundations. Limestone is considered to be the result of a continuous and almost

* Phillips.

uninterrupted series of chemical changes. The proportions of mechanical to chemical deposits of water are estimated as follows:—

In the Primary series they are as		500 to	1
" Carboniferous system	. .	10	1
" Oolitic "	. .	4	1
" Cretaceous "	. .	2	1
" Saliferous "	. .	5	1
" Tertiary "	. .	10	1

"The fossil remains found in strata consist of an almost endless variety of terrestrial plants, and of both land and water animals. The coal districts are the great depositories of the former, coal being itself considered a vegetable production, and the beds of that mineral, vast masses of plants swept down by inundations into estuaries and lakes, there covered with sand and clay, and converted by chemical depositions into their present substance. By this agency they were in part deprived of their oxygen and hydrogen, the carbon chiefly remaining pure, or mixed with bitumen, carbonate of lime, or with flint or pyrites. Thus the anthracite coal of Kilkenny contains only 4 per cent. of volatile matter, and 92 per cent. of carbon; cannel coal 50 per cent. of volatile matter, and 50 per cent. carbon; common coal 70 per cent. carbon, and 30 per cent. oxygen and hydrogen.

"The animal remains consist of zoophytes, both stony and flexible, with their delicate and beautiful organization; molluscous animals, which are the most numerous of all tribes of marine animals, and the most abundant of organic fossils; articulated animals, or such as have movable joints, as lobsters, crabs, and other Crustaceæ similar to the living species, and others which have nothing analogous in them to the present races. Fossil insects are rare, and only the harder parts of those are found remaining. The distribution of organic remains is very unequal; some rocks are filled with shells, while others contain none. The forest marbles and coarse upper beds of Bath oolite are composed of little else than shells, while the sandstone of a whole coal district may contain not one." (Phillips.)

Soils formed of the disintegrated materials of granite, although they contain but few organic remains, are well adapted to agricultural purposes, depending, however, in a great measure on the character of the felspar and hornblende in the rock from which they are derived. The following are the elements contained in the several productions of granite, and their proportions:—

Quartz is almost pure silex, containing 99 per cent. of that substance.

Felspar contains 60 per cent. of silex, 22 alumina or clay, 14 potash, 1 iron, and 1 lime.

Mica contains 46 per cent. silex, 30 alumina, 8 potash, 8 oxide of iron.

Hornblende 42 silex, 12 alumina, 13 magnesia, 11 lime, 15 oxide of iron.

The iron and potash perform a principal part in the disintegration of the granite; wherever it comes within the influence of the atmosphere the oxidisation of the iron and the dissolving of the potash cause it to decay. The soil formed with the above proportions only needs the aid of manure to produce any kind of crop. If, however, it rests immediately upon the granite rock, the impermeable nature of that base prevents the water from the higher grounds from filtrating through it, and the soil is consequently wet and cold. If, too, it is much elevated above the level of the sea, where the atmosphere acts upon the oxide of iron, the land is not very valuable. The principal granite districts of England are Cornwall, Devonshire, and Westmoreland. Some considerable tracts of land on the granite formation on Dartmoor, have recently been reclaimed by Mr. Fowler at great expense in drainage, blasting the boulders of granite, and manure. Under this treatment they have been rendered highly productive of roots and cereal produce.

The trap rock, or basalt, contains much the same elements as the gneiss, namely, felspar, hornblende, oxide of iron, potash, lime, &c.; and, as in the case of granite, the iron and potash assist in the decay of the rock. The soil formed of this rock is exceedingly productive. It is said that in Cornwall, near Penzance, the proprietor of 1,000 acres realises a rental of £10,000 a year by it. Two crops of potatoes are produced in the season, which, however, is partly owing to the mildness of the climate, tempered as it is by the western breezes and the influence of the "Gulf Stream," which loses itself on the western coast of England.

In ascending from the upper beds of the Silurian, we come to the tile-stone, so called from the thinness of its beds, which fits it for roofing purposes. This stone is the lower series of the Old Red sandstone formation. The central member of this is composed of alternate beds of reddish grey, and greenish red, argillaceous marl. More frequently, however, this latter alternates with argillaceous beds of concretionary lime, often in large nodules, holding a considerable portion of iron and clay in their composition. It is called dunstone, and when exposed to the atmosphere rapidly decomposes into a reddish earthy marl. This marl is of great breadth in Herefordshire. Next to this comes the conglomerate or pudding stone, a compact, coarse-grained sandstone from 1 foot to 5 or 6 feet thick. It is used in building, and is frequently raised in blocks of 20 feet long and 6 inches in thickness. The beds are divided by layers of pure sand, or by dry fissures, and above them are thin beds of pure sandstone with a considerable portion of mica in its composition.

The upper beds of the Old Red are a conglomerate of whitish quartz pebbles in a reddish matrix of iron sandy clay. This is succeeded by a coarse-grained sandstone in thin beds, and both are used in building. The soil on the hills formed of the tile-stone strata is thin, cold, and hungry, producing naturally a poor, wiry kind of grass; but the surface of the middle part of the hills is a mixture of argillaceous marl and siliceous sand, forming a rich, strong soil, producing an abundance of wheat and barley, and excellent pastures. It extends over parts of the counties of Hereford, Monmouth, and Brecon. The cornstone, or cornbrash, soil is a reddish, greasy marl, which retains the manure long, and produces every kind of crop. It is, however, compelled to receive the rain which falls on the tile-stone above it, the pervious nature of which prevents it from retaining, and it issues in springs and overflows the land below.

The mountain limestone prevails in Wales, and in the counties of Derby, Somerset, York, Cumberland, Westmoreland, &c. It is the base of the coal formation, and sometimes is composed wholly of shells, others are pure carbonate of lime, whilst others contain silex and clay. The soil above the carbonaceous lime is thin and formed chiefly of vegetable mould mixed with fragments of limestone. It bears, however, an excellent herbage for sheep. It is therefore chiefly kept in pasture, but when cultivated produces good crops of corn and roots, &c.

The soil above the coal formation is a wet, poor, yellow clay, producing naturally a sedgy herbage and heather. The exception to this is where the soil contains a large portion of sand, which renders it productive with good cultivation. Lime is applied to it with great effect after it has been drained. The magnesian limestone is the base of the Saliferous formation; it traverses a level country, inclining to the south-east; its composition is varied, being in some places formed of angular fragments of mountain limestone, in others of round pebbles of limestone and other older rocks cemented into a conglomerate by a yellowish magnesian earth. The upper soil is formed of fragments of rocks, and is thin, light, friable, and easily cultivated, producing every kind of crops, both cereal and green.

The New Red sandstone is chiefly composed of reddish or variegated coloured marl, under which lies the salt rock. In some places it easily decomposes, and forms a deep, dry, sandy soil; where it lies over a porous subsoil it is rich and productive, but where over an impervious clay it retains the rain and becomes wet and cold, unless well drained, which is indispensable to its fertility. In other places where the red marl and friable marly sandstone occur, a deep red friable loam is produced, fertile in its nature, and yielding produce of every kind in abundance. It is the most general formation in England, extending from Torbay, in Devon, through the counties of Gloucester, Worcester, Warwick, Nottingham, and York, to the mouth of the Tees; and from Birmingham through the counties of Stafford, Cheshire, and Lancashire, its breadth being from 30 to 80 miles in the midland counties. In Devon and Somerset it forms an unctuous and friable red marly soil, rich and most productive. Where sand prevails it is a porous light-red sand, or loose sandy gravel, or a good loam suitable for wheat and other cereals. The marl is found to be a good dressing for the lighter soils. The district over the New Red sandstone is level generally, but it also contains a few elevations formed of drift and diluvium, chiefly gravel and sand, as is found in Staffordshire.

The lias is above the red marl of the New Red sandstone, and below the lower oolite. Under a yellowish black clay, and beds of indurated clay slightly calcareous, is a deposit of lias limestone in beds from two to ten inches in thickness, and containing from eighty to ninety per cent. of carbonate of lime, with alumina and iron. When burned, it forms an excellent cement for water-masonry. These thin beds of lime alternate with others of blue or yellow clay, and by shales of considerable thickness, impervious to the water, which has filtrated through the oolitic rock above it, and which is therefore thrown upon the lias. This keeps the surface wet, but if the land is drained, it forms excellent pasture for cows, and produces the richest cheeses, and more in quantity than on the New Red sandstone or the oolitic soils.

The Oolitic formation is divided into three principal divisions, each of which has several subdivisions. The lower oolite is sandstone and unctuous marl, then shaly calcareous limestone, next the slate used for roofing, then the great oolite, then the rag-stone, composed of comminuted shells. The middle oolite is, first, Oxford clay, dark blue and tenacious, and containing beds of bituminous shale, and nodules of *septaria* (or calcareous marl) and sandstone. Above this is the coral rag, with beds of siliceous matter, with grains of oolite as large as peas, termed mineral *pisolite*. The upper oolite begins with Kimmeridge clay, a bluish yellow clay, or shale, then the Portland oolite, and the sand of the Portland stone. The clay is impervious, and throws up the water of the porous oolite, which keeps the soil wet. The soil of the oolitic rock, like the subsoil, is composed of minute particles and angular fragments of the rock, with little decayed matter in it. It varies considerably, but the agricultural characteristics of the varieties are much alike. The whole of the oolite clays are close, adhesive, and calcareous; and the soil from them is difficult to cultivate as arable land, except when well drained; it then forms excellent pastures, and in some places, as in Wiltshire, is well known as dairy land of the first quality. In other parts the Kimmeridge clay prevails—an impervious clunch of great thickness. Northamptonshire and the borders of Huntingdonshire are placed over this clay, and the soil naturally produces poor grass until it is drained, and well cultivated, when it produces wheat in abundance.

It remains but to refer to some of the more peculiar strata which prevail in some districts, and which have an influence beneficial or otherwise on agriculture in the districts in which they prevail.

Gault is a blue, or dark grey, strongly adhesive clay. It effervesces with an acid. It is a close, solid, compact mass of impervious substance,* lying under the edge of the chalk hills. It prevails in Cambridgeshire, Buckinghamshire, and Berkshire—in the Vale of the White Horse. The calcareous nature of this clay renders it very susceptible to the influence of the weather. After a dry season, when rain falls, it slakes like quicklime into a fine powder; it also is equally affected by frost, and produces the *root-fall* when a thaw occurs.

The green sand, of which the gault is a sub-member, is divided by it into the upper and the lower. It is found under the whole range of chalk hills; and the soil into which it decomposes is rich and easily cultivated. In some parts it is a deep friable loam, bearing wheat and beans, and excellent barley, &c. It is found in Bedfordshire, Buckinghamshire, Berkshire, Warwickshire, Devonshire, and Somersetshire; but its breadth is nowhere very great. In some parts it is too loose in quality, and improves if mixed with the gault. It is rich in phosphoric acid.

The Chalk formation is divided into three sections, the lowest of which is the chalk marl, the surface soil of which abounds in the mineral elements of fertility. With the green sand, it is the most productive soil in the kingdom for every kind of crop, and of the finest quality. The lower chalk proper is found in beds of various thicknesses, from one to two feet, on the chalk marl, from which it differs in being more pure and more compact. It is used as building stone. Masses of sulphate of iron are found in the middle section of the chalk. The upper chalk is carbonate of lime, with nodules of black flint between the layers of rock. The natural produce of the chalks is a short, close sheep pasture; and, as arable land, when well cultivated, it produces good crops of wheat, barley, &c. It prevails in the counties of Wilts, Hants, Buckingham, Oxford, Hertford, Cambridge, Suffolk, Norfolk, Lincoln, York, &c.

The plastic clay rests on the upper chalk, and is a series of beds of sandy clay of various thicknesses. The soil above is generally a light sand, rendered wet by the beds of clay which alternate with the sand, and thus forms bogs and mosses. If drained and

* The writer recollects a singular circumstance illustrative of the depth and the properties of this clay. Sixty years ago, at a farm near Abingdon, in Cambridgeshire, some men were employed in sinking a well. They had dug 200 feet through the gault without meeting with water enough to wet their spades. At length, they began to perceive symptoms of water in a dampness of the clay: as it was twelve o'clock, they would not then proceed with the work, but left their tools, and ascended to get their dinners. Upon their return to resume their work, to their astonishment, they found the well brim full of water. They had reached, probably, within a foot or two of the great subterranean reservoir of water, which, thus forcing its way, had gushed up till it reached the surface of the earth. The men lost their tools, but saved their lives.

well cultivated, it yields fair crops of roots and grass, the quality of which is good, if the quantity were sufficient. The natural pasture on this soil is a poor, benty, worthless grass, with heather, broom, and furze.

The London clay rests on the plastic clay, and is an argillaceous deposit of a bluish-black colour, and contains calcareous matter, with micaceous and siliceous sand and iron, nodules of *septaria*, or cement-stone. It extends round London, on both sides of the Thames to Windsor, and to Harwich, in Essex, and Reculver, in Kent, being about twenty miles in breadth, from Barnet to Croydon. The soil above is a brownish clay. In dry weather it contracts, and forms fissures through which the rain, when it falls, finds a passage to the drains. When well cultivated and thoroughly drained, it produces wheat and beans in abundance, but is too strong and tenacious of itself for roots. The grass on this soil is rich and luxuriant, being generally highly manured.

The crag rock prevails along the north side of the Isle of Wight from Alum Bay through Cowes, Ryde, and Nettlestone, to Bembridge. The stone is solid, and is used in large quantities for building purposes. It is a calcareous shaly mass, containing a considerable portion of siliceous matter. Beds of argillaceous marl occur in the Crag, which gives the whole district a clayey character. The soil above the Crag, along the north side of the Isle of Wight, is consequently a calcareous clay, having in some places a more sandy mixture than in others. When drained and well cultivated, it is tolerably productive of grain and roots. A second narrow strip of crag is found on the eastern coast, from Harwich to Yarmouth. It is of a loose shaly character, mixed with siliceous sand. In some places it is more solid, and is used for building. The looser portion is used for top-dressing on a clay soil. The land is light, formed of finely comminuted shale and siliceous sand, which blows into drifts in very stormy weather. Rainy seasons are favourable to it, and it then bears heavy crops of barley and roots; but in a dry, hot season the crops are burnt up. It is in the crag formation that the coprolites are found, and are used in the manufacture of artificial manure, on account of the large proportion they contain of phosphate of lime. A third district in which the crag prevails is that of Bagshot Heath and Beaulieu Forest, in Hampshire, and it is found in beds of loose siliceous sand of various colours, light and porous. The natural produce is heather, but the sub-soil is clay, which, if mixed with the upper soil, renders it productive. In this way a portion of Bagshot Heath has been brought under cultivation, and is found to be much more profitable in the growth of roots than the general character of the districts was considered capable of.

A large portion of the land of England rests upon the New Red sandstone, the soil of which is exceedingly fertile. The lias requires to be mixed with marl to render it friable: when thus treated and manured it becomes productive. Limestone, when pure, possesses no fertility, and requires to be mixed with clay. Magnesia is an essential constituent of soils, and with lime, potash, and soda, are of great importance in forming bases, which, when mixed with oxygen, are in a condition to be absorbed by plants. None of these alone possess any fertility. The cretaceous (or chalky) group-soils vary. Those of the lower green sand are exceedingly rich, and the upper chalk forms extensive downs, producing a short sweet herbage for sheep pasturage. Those of Sussex, Hampshire, &c., are exceedingly valuable for that purpose. It is evident that the erratic tertiaries are of the first importance to agriculture, as forming the soil on the surface, and affording the materials for its renovation and improvement.

To the drift deposit, therefore, the upper surface or soil is to be mainly ascribed, and its fertility or otherwise depends on the composition of the rock or rocks from which it has been detached. The sub-soil likewise is possessed of similar properties, and is valuable for the improvement or renovation of the surface, according to the constituents of which it is composed. It is remarkable that in none of the strata of the Tertiary formation have the remains of any human beings or their works been discovered. Whilst the bones of the ox, the horse, the elephant, and many other of the now domesticated animals, with those of various beasts of prey, have been found in abundance, those of man are wholly absent; or, if present, can be accounted for from accidental or other appreciable causes, totally apart from the co-existence of the subject of them with the inferior animals of the period. The inference to be drawn from this fact is, that the earth was created for man, and that it was not until everything thereon was prepared for his existence that he was himself created; and when he appeared, the inferior animals flocked around him, as is graphically recorded in the Scriptures, totally unconscious of danger, to receive their names: and thus the work of creation, as well as the geological structure of the earth, received its final accomplishment.

SECTION IX.

AGRICULTURAL BOTANY.

Botany implies a knowledge of the nature and affinities of plants, ascertained by examination of their constituent parts, so as to be able to classify and arrange them into distinct tribes. It is only within a comparatively short period that botany has been divided into two branches, namely, *systematic* and *physiological* botany. The former alone was known to the ancients, and their acquaintance with it was very imperfect; the latter has arisen out of the discoveries of chemistry and the microscope. By the first of these the elementary constitution of plants was laid open; whilst by the second their material and mechanical framework was brought palpably before the eye. We shall in the first instance give a general idea of the systematic arrangement adopted by botanists for separating the vegetable world into divisions and subdivisions, including *genus, species, orders, families, tribes,* &c. &c.

The use of systematic botany to a farmer is to make him acquainted with the characteristics of the plants that come under his immediate notice, whether as of a kind to be the subject of cultivation, or as weeds to be destroyed and eradicated. And here it may be proper to observe that the business of the modern botanist is not generally or necessarily directed to a discovery of the utility or otherwise of plants, which was the main object of the older botanists, or herbalists. The latter always accompanied their descriptions of plants with an account of their medicinal, nutritive, or poisonous qualities; and if these are in some cases referred to by the moderns it is incidentally, and not of necessity; for a man may be a good systematic botanist without knowing the medicinal properties of a single plant. These belong strictly to the herbalist, who studies the subject with the sole view of making them available in the cure of disease.

Systematic botany embraces the classification of plants into species, families, genera, or orders, classes, and sub-classes. Without such an arrangement the utmost confusion would arise in studying the characters of plants, the number of which at present known, is said to be 120,000. Linnæus, the author of the present system, founded his theory on the simple principle and arrangement of the *stamens* and *pistils;* the former being the threadlike substances found in the *corolla,* or outward leaves of the flower; and the latter the column standing in the centre of the stamens. By a reference to the stamens, the degree of relationship between plants is ascertained, with their names, structure, affinities, and properties. This is styled the *artificial* system of botany; the *natural* system having reference to the entire structure of the plant. Under the more refined, or artificial, arrangement, we arrive at a more precise acquaintance with the structure and characteristics of a plant, so as to be able to determine at once its affinities, a knowledge of which assists us to judge of its properties. An artificial system, therefore, is simply a guide to the names of plants, and furnishes no other information respecting them.

The term *species* has been defined as implying a collection of individuals (whether plants or animals), possessing certain characteristics in common, and having been derived from one common stock. They may present differences in size, colour, and other peculiarities; but the general resemblance to each other is more close than to any other plants, and their seeds produce similar individuals. The varieties we see in plants of the same species arise from their tendency to *sport,* as it is termed by gardeners; and these changes are afterwards perpetuated, under culture, by their seeds. All the varieties of the cabbage, cauliflower, savoy, rape, &c. &c., for instance, owe their origin to one common stock, the *Brassica oleracæa,* which grows wild on the sea-shore, and undergoes all these transformations by cultivation.

The word *genera* is used to represent an assemblage of *species,* not having a common origin, but possessing certain features of resemblance in common, which prove their affinity. They agree with each other in general structure and appearance more closely than they do with any other species. Thus the Scotch rose, the dog rose, the China rose, and the sweetbriar, are all different species comprised in one *genus,* "*Rosa.*" Certain genera may be grouped into *families* or orders. Thus genera are allied species, and orders or families are groups of allied genera, or more comprehensive genera. Thus also various pines and larches belong to different genera, but all agree in bearing cones, and are consequently placed in the order *Conifera.* Again, the rose, the raspberry, the strawberry, the cinquefoil, the plum, &c., all agree in the general organization, and are united under the order *Rosaceæ.*

Every flower consists of six principal parts, namely, the *calyx,* the *corolla,* the *stamen,* the *pistil,* the *pericarp,* or seed vessel, and the *receptacle.*

If you take a flower,—a convolvulus, for instance,—and examine it, you will find that it terminates at the lower end in a green cup, which encloses it quite round. This is the *calyx.* There are six kinds of calyxes:—1st, the *perianth,* as that of the rose; 2nd, the *involucre,* that of the hemlock, carrot, &c.; 3rd, the *sheath,* which encloses the flower, as in the daffodil, &c.; 4th, the *glume,* a chaffy substance by which the seeds of grasses are protected; 5th, the *calyptra,* the calyx of mosses, &c., which is placed on the top of the flower; 6th the *volva,* which distinguishes the mushroom tribe of plants.

The *corolla* is the outer part of the flower, and is formed of one or more leaves, termed *petals,* which are generally coloured different from the common leaves, and constitute the principal beauty of the flower. The convolvulus has only one petal, from whence it is called a *monopetalous* plant. The corolla springs from the calyx, and the upper part of a monopetalous flower is called the *limb;* and the lower end, which springs from the calyx, the *tube.* Where the leaves of the corolla are numerous, the flower is called *polypetalous.* The base of the petals of the corolla in these, is a *claw,* the expanded part, the *border.* Corollas are of various kinds, according to their shape, as the *campanulata,* or bell-shape; the *infundibuliformis,* or *funnel-shaped;* the *rotata,* or wheel-shaped, &c., in the monopetalous; and the *cruciform,* or cross-like; the *rosacea,* spreading like a rose; the *papillionaceous,* irregular, and somewhat like a butterfly, whence its name, &c. &c. The use of the corolla is to protect the inner and more tender parts of the flower, and especially the embryo seed vessel, from the cold air, the rain, and other causes of injury. Darwin supposed that the corolla acts as the lungs of the stamens and pistils which are enclosed within it. It generally fades and falls off as the seed ripens. In double flowers it lives longer than in single, the plant not being exhausted by the formation of seed. Some flowers have only one covering, in which case, if green, it is called a calyx; but if it is delicate in form, and coloured otherwise than green, it is a corolla.

The *stamen* is placed within the corolla or calyx, and is formed of two parts; a number of thread-like filaments, supporting on the top the anthers, which when ripe burst and disperse the pollen they contain in the form of fine dust, which is the fructifying principle, and without which there would be no fruit or seed. The *pistil* is placed in the centre of the flower, surrounded by the stamen. It consists of three parts—the *germen,* the *style,* and the *stigma.* The *germen* is the globular seed-vessel placed at the bottom of the corolla, and contains the seeds. The *style* is the pillar springing from, or a continuation of, the germen; it supports the *stigma:* the office of this latter is to receive the pollen which impregnates the flower, and renders it fruitful. A *nectary* is sometimes attached to the pistil, which elaborates, or secretes, the honey which is contained in greater or less quantity in the flower. The nectary is differently formed in different plants. In monopetalous plants the honey is secreted in the corolla: in others the corolla is elongated for the purpose; whilst in others the honey distils in the calyx.

The *pericarp* is the external part of the germen, and contains the seed when matured. It is of different forms and substance. The pericarp of the poppy is globular and hard, that of the pea is long and soft. The plum has a pulpy pericarp, covered with a thin skin, and containing a stony seed. In the pear and apple the seeds are enclosed in a thin case. The pericarp of the nut is a hard shell containing a kernel, which is the proper seed. The pericarp of the fir-tree is a hard scaly cone containing many seeds protected by the scales.

The *receptacle* is the base of the whole flower, supporting it till the fruit or seed is fully formed. It then falls off and leaves the fruit suspended on the base to ripen.

The root of a plant consists of the *caudex,** or principal part; and the fibres or *radicula,* which supply the plant with nourishment from the earth. The root both supports the plant in the soil, and sustains it with food. For this purpose the fibres are

* Caudex is applied to the stem. In this case it represents the body of the root.

furnished with spongioles at their extremities, which absorb the elements of food reduced to a liquid or impalpable form by the chemical agents provided by nature in the soil; this has already been fully explained in treating of physiology. Many plants exist without being rooted in the ground, and are thence called "air plants." Some or most of these attach themselves to the bark of trees and plants, into which they strike their rootlets, and derive their nourishment therefrom, as the misletoe, the dodder, and the tribe of Orchids. These are termed parasitical plants on that account. Some roots are annual, others biennial, and others perennial. They are also of various forms, as—1st. *Radix fibrosa*, or fibrous root, which branches out into the soil and collects the nourishment, which it conveys directly to the plant. It is the most simple kind of root, and many of the grasses and annual herbs have this kind. 2nd. *Radix repens*, or creeping root. This kind generally throws out long branches horizontally, which form fibrous roots at short intervals, every knot being reproductive, and prepared to form a new plant of equally prolific powers. The farmer, to his sorrow, is too well acquainted with this kind of roots, as represented by the *Triticum repens* (creeping wheat), or couch-grass or twitch; the *Holcus mollis*, another of these vegetable pests, &c. &c. 3rd. *Radix fusiformis*, that of the carrot, parsnip, &c. The tapering form of this root enables it to penetrate the soil perpendicularly. 4th. *Radix præmorsa*, a root similar to the carrot, but cut off, as it were, a little below the ground. The *Scabiosa succisa*, and some of the hawkweed species of plants, have this root. 5th. *Radix tuberosa*, a knobbed or tuberous root, as the *Solanum tuberosa* (the potato), the *Helianthus tuberosa* (Jerusalem artichoke), &c. It consists of fleshy knobs of various forms connected together by fibres, and forming reservoirs of moisture, nourishment, and vital energy to the plant. 6th. *Radix bulbosa*, a bulbous root, whether solid as the crocus; or composed of concentric layers, as the onion tribe; or consisting of fleshy scales, as the lily (*lilium*). These latter are analogous to leaf buds, and supply the plant with the means of sustaining its vital energy during the season when they are torpid and inactive. 7th. *Radix articulata* or *granulata*, a jointed or granulated root, the first being analogous to the scaly, the second to the solid bulbs.

The leaves are the most fragile parts of the structure of a plant, and present a broader surface to the atmosphere than all the rest of it put together. When in health the colour is generally green, and its internal substance vascular, and more or less succulent. The leaves contribute largely to the support of the plant, and are furnished with organs for receiving nourishment from the atmosphere. They are of various kinds, as—1st. *Folia radicula*, radical leaves, which spring from the root, as the cowslip, primrose, &c. 2nd. *Folia alterna*, alternate leaves; these are placed apart from each other on the stem or branch in different directions, as in the borage, &c. 3rd. *Folia ternate*, as those of the verbena, &c. 4th. *Folia verticillata*, whirled leaves; these grow in a circular form round the stem, as in the mare's tail, &c. 5th. *Folia lanceolata*; these are in form of a lance-head, as those of the willow and many others. 6th. *Folia lineare*, linear narrow leaves, as those of the grasses, &c. 7th. *Folia triangulare*, triangular, as in the ivy, &c. 8th. *Folia deltoides*, trowel-shaped, having three angles, as in the Danish scurvy-grass, &c. 9th. *Folia petiolata*, leaves on foot-stalks. 10th. *Folia sessilia*, sessile, springing immediately from the stem, branches, or roots, without footstalk, as the alkanet, butterwort, &c. 11th. *Folia subrotundum*, a roundish leaf as that of the pyrola, winter green, &c. 12th. *Folia ovatum*, ovate, the shape of an egg cut lengthwise, as the nettle, periwinkle, &c. 13th. *Folia oboratum,* obovate; the same in figure with the foregoing, but the broad end is uppermost in this, whilst in the former it was reversed. 14th. *Folia reniform,* kidney-shaped, a short, broad, roundish leaf, hollowed out at the base, as in the oxyria, or mountain sorrel, &c. 15th. *Folia cordatum,* heart-shaped, as in the black bryony, *Viola odorata* (sweet violet), &c. 16th. *Folia runcinatum,* runcinate or lion-toothed, as the dandelion (a corruption of the French *dent-de-lion*). 17th. *Folia laciniatum,* laciniated, or cut into irregular portions, as in the crane's bill, &c.

We now proceed to explain the Linnæan system of the artificial division of plants, as it has been modified by subsequent botanists, but without departing from the principle laid down by its founder, so that it is still, with the greatest propriety, named after him. The following are the divisions :—

1. Plants with Stamens definite and equal.

Class	1.	Monandria, or with	1	stamen.
,,	2.	Diandria ,,	2	,,
,,	3.	Triandria ,,	3	,,
,,	4.	Tetandria ,,	4	,,
,,	5.	Pentandria ,,	5	,,
,,	6.	Hexandria ,,	6	,,
,,	7.	Heptandria ,,	7	,,
,,	8.	Octandria ,,	8	,,
,,	9.	Enneandria ,,	9	,,
,,	10.	Decandria ,,	10	,,

2. Plants with Stamens indefinite.

Class 11. Dodecandria, from 11 to 19 stamens.
,, 12. Icosandria, stamens 20 and upwards, hypogenous, or inserted in the calyx.
,, 13. Polyandria, stamens 20 and upwards, hypogenous, or inserted in the receptacle.

3. Plants with Stamens unequal.

Class 14. Didynamia, stamens 4, two longer than the others.
,, 15. Tetradynamia, stamens 6, four longer than the others.

4. Plants with Filaments united

Class 16. Monadelphia, one bundle of stamens, or *androphere.*
,, 17. Diadelphia, two bundles of stamens.
,, 18. Polyadelphia, several bundles of stamens.

5. Plants with Anthers united.

Class 19. Syngenesia, stamens 5, united by their anthers—flowers collected into a common involucre.

6. Plants with Stamens united to a Pistil.

Class 20. Gynandria.

7. Plants with Flowers unisexual.

Class 21. Monœcia, stamens and pistils in the same individuals.
,, 22. Diœcia, stamens and pistils in different individuals.
,, 23. Polygamia, hermaphrodite and unisexual flowers, either in the same or different individuals.

8. Plants with Flowers invisible.

Class 24. Cryptogamia, having neither stamens nor pistils.

The first twenty-three classes are *phanerogamous* vegetables (having the reproductive organs visible), some of which have flowers hermaphrodite or double sexed; others are *diclinous,* or have them in separate flowers. Of the former there are twenty, and of the latter three classes. The hermaphrodite or bisexual flowers may have the stamens free from the pistil, or united to it. Only one class belongs to the latter, and nineteen to the former.

In the first thirteen classes the characters of the orders, or subdivisions of the classes, are taken from the number of styles or family organs, the names indicating respectively one, two, three, or more styles or stamens. The 14th class was named from the structure of the fruit. When this is formed of four *akenia* (or seed vessels) lying at the bottom of the calyx, so as to resemble naked seeds, the order is called *Gymnospermia.* When the fruit is a capsule containing several seeds it is named *Angiospermia.* The 15th class, *Tetradynamia,* includes two orders; one with a *silicula* (or pod as broad as it is long), the other with a *siligna* (or long narrow pod).

Classes 16, 17, and 18 are named according to the union of the filaments, the number of stamens being employed as a character for the orders. Class 19, *Syngenesia,* in which the anthers are united, and there are usually five stamens, is named accordingly, from the cylindrical form in which the anthers are placed. Some flowerets were found to be bisexual, others with stamens or pistils only. The 23rd class therefore is, in its three orders, named *Polygamia,* with another epithet to mark their respective peculiarities. The first is termed *Polygamia equalis,* all the flowers being equally productive and bisexual. The second, *Polygamia superflua;* the flowerets of the centre are bisexual, but those of the circumference are real females, producing perfect fruit.

Class 24, *Cryptogamia,* consists of flowerless plants in which the organs of fructification are entirely, or very nearly, concealed by their diminutive size, or their position in the plant. In the Linnæan system of arrangement this class is perfectly in accordance with nature, and it has not been materially altered in the natural system of modern botanists. The principal alteration is that of having subdivided his four orders, *Filices, Musci, Algæ,* and *Fungi,* and added the genus *Chura,* which had been placed by the great botanist in the class *Monandria.* These are represented by ferns, mosses, liverworts, flags, and mushrooms.

In the ferns the fructification takes place mostly on the back of the leaves, which is proved by the production of seeds, but in some they are found at the summit or near the base of the frond. The ferns are a very numerous and beautiful tribe of plants, and in tropical climates some of them attain a considerable height.

The *Musci,* or mosses, are also very numerous and beautiful, found in all climates, and very tenacious of life, being restored to vitality by moisture after having been long dried. The *Hepaticæ,* or liverworts, are herbaceous plants, the fructification originating from the leaf and stem. Some of them (as the *Marchantia*) are a very prolific order of plants, and occasion great trouble to the gardener and florist, overrunning beds and pots of flowers that require constant moisture, as well as beds of Alpine or American plants.

The *Algæ,* or flags, are the fourth order, and are very numerous, and include seaweeds and lichens. Linnæus divided the latter into nine sections, each of which was subdivided into several species. The *Fungi* or mushroom tribe of plants comprehends all those plants which bear a resemblance to the mushroom. Some of these, as is well known, are highly poisonous, whilst others, such as the proper mushroom and truffles, are very much esteemed at table.

Having thus briefly described the artificial system of Linnæus, we shall next speak of the natural system of Jussieu, as adopted or modified by subsequent botanists. The following is his arrangement:—

				Class.
Acotyledones				1
Monocotyledones		Stamina hypogyna		2
		,, perigyna		3
		,, epigyna		4
Dicotyledones	Apetalæ	Stamina epigyna		5
		,, perigyna		6
		,, hypogyna		7
	Monopetalæ	Corolla hypogyna		8
		,, perigyna		9
		,, epigyna	anther united	10
			anther free	11
	Polypetalæ	Stamina epigyna		12
		,, hypogyna		13
		,, perigyna		14
	Diclines irregulares			15

These classes have been subdivided into a hundred orders, beginning with the Fungi, and ending with the Conifera.

Such are the elements or first principles of the system of botany, natural and artificial, adopted by modern botanists, and we have given them a place in our work rather with the view of stimulating the study of the science, than that of conveying any adequate idea of its length and breadth. So far as an artificial system is concerned, it is in itself of little use to an agriculturist, whose acquaintance with the science may be supposed to be advantageous only as it relates to the plants which are the immediate object of his attention. But it would be an error to suppose that even such a view of its value would confine the study of the farmer to a few plants, in their characters, habits, and properties. There are a multitude of species both useful and noxious, and especially the latter, with which he has to do, and the study of which will materially assist him in either the proper cultivation of the one, or the extermination of the other. The germination of seeds, for instance, is one of the subjects first in importance to him; and although practice alone may impart a certain extent of knowledge, it is science alone that can enable him to obtain an accurate and intelligent acquaintance with the causes of certain vegetable phenomena, either of a beneficial or an injurious tendency, so as to be able to apply in his practice a stimulant to the one, or a corrective to the other.

We have already spoken of physiology, a knowledge of which is essential to a proper acquaintance with botany. At the same time it must be obvious that as physiology is applicable to the animal kingdom as well as the vegetable, it was necessary for us to treat it as a separate science, and, after chemistry, to give it a priority as we have done. Still vegetable physiology stands foremost in importance with the farmer, the success of whose operations are all in a great measure dependent upon a knowledge of the principles of nature, and of the causes of the phenomena she presents to him in the growth of plants; and these are so intimately connected with the other branches of science, that he cannot study the one without seeing the value and importance of the other. The analogy between plants and animals, and their mutual dependence, mediately or immediately, upon the earth for existence, the similarity of the mode of their reproduction, and the graduated scale of vitality by which the one merges, and is lost, in the other, are amongst the most interesting and important facts in natural history. The more, too, these are studied, and the more closely the interior structure of plants is examined, the greater proofs shall we obtain of design and fitness in the works of nature, and of the impossibility that inert matter should ever have been able to mould itself into those beautiful forms and minute contrivances for the support of life, which the microscope has revealed in the construction of plants. Every step in the study of physiology gives evidence of an omnipotent creative power and a superintending Providence; and the meanest plant that grows, as well as the most towering monarch of the forest, proclaims alike "that the hand that made it is Divine."

SECTION XI.

METEOROLOGY.

There is perhaps no class of men whose success in business is so dependent on atmospheric phenomena as the farmer's, or whose talent of observation on the various indications of changes of the weather is so much and so frequently called in requisition. Every step he takes in the prosecution of his calling, every moment of the season, from the time of the preparation of the land for putting in the seed to that of the harvesting of the produce, is accompanied with more or less of anxiety and calculation of the state of the weather, as affecting the ultimate success of his operations. Too much or too little heat or moisture, too long a continuance of any of the conditions of seasonal temperature, excite alternately his hopes and fears, and tax his patience; nor can he ever consider himself safe until the fruits of the season are well and safely housed. Helpless as an infant in the midst of the vicissitudes of the weather, the husbandman, above all others, must feel that his dependence is on a higher power, and that, after all he can do by the exercise of the most energetic efforts, and the most enlightened policy, a single night of undue severity of temperature, a breath of poisonous miasmata, a blast of the hurricane, may neutralise his plans, blight his prospects, and dash his hopes, for the season, to the ground.

The science, therefore, of meteorology is of tenfold importance to the farmer, whose success is thus liable to be affected by changes over which he has no control, and he has consequently, from age to age, sought the means of collecting and registering those prognostics of the weather which observation has enabled him to discern. These have been made without reference to scientific arrangement or deduction, and are the result of experience and observation alone, independent of a consideration of remote causes, and we therefore find many of them fanciful, and others superstitious, whilst but few are accounted for upon rational or logical principles. As in other departments of natural philosophy, so in meteorology, empiricism has taken the place of scientific investigation, and a series of maxims more or less, and only by chance, correct, instead of a code of natural laws, has ruled the ideas and actions of the cultivators of the soil.

A great deal of attention has of late years been bestowed upon this science, and some progress made in reducing the phenomena of the atmosphere to a system. Meteorology, however, is still in its infancy, and the process and means of observation involve so long a period to determine the truth and correctness of the data upon which deductions are to be based, that the longest life of man is scarcely sufficient to enable him to master all the details, and even to cross the threshold of the subject. Nor is this to be wondered at, when it is considered that the data themselves are many of them so remote and occult as to be beyond the grasp of ordinary minds to perceive, or to calculate their bearings. The chemist has sure bases to work upon in the analysis, and the microscope is a safe and unerring guide to the physiologist; the surgeon is guided in his operations by the light of comparative anatomy, and the mechanician works upon laws as fixed and precise as those of the earth itself. But the meteorologist, whilst observing the immediate influence of the phenomena around him, knows that the lesser cycle, on which he forms his theory, is itself influenced by others more extended and remote, and those by others still further removed from human observation, and so on, until they reach to thousands of years, leaving all calculation of their influence upon our planet at an immeasurable distance.*

"When we consider," says a modern writer, "the peculiar conditions connected with every atmospherical problem, the large advances that must be made in every capital portion of knowledge, before one successful step can be made in this, the subtle nature of the medium which is the subject of investigation, its singular relations to moisture, the changes it undergoes with every alteration of temperature, in one region influenced by the full power of a vertical sun, and in another chilled by the frozen masses of the polar zones, &c., ... all these, and a thousand more complicated inquiries beset the investigator at the very threshold of meteorology, stimulating him to ardent investigation, and inspiring him with wholesome caution." †

There was a time when the earth was considered to be the centre of the universe, around which the sun and the stars were supposed to revolve. Astronomy has taught us that not only the earth, but that the solar system itself is but an infinitesimal part of the universe, and that there are thousands of systems as large, or possibly larger, than that with which this earth is connected. It is now believed by astronomers that the sun and its planets, as a system, have also an orbit round a grand central focus, ‡ at present undiscovered, but of which some facts have been determined. Dr. Brewster, in reference to this immense subject, remarks, "If the buried relics of primeval life have taught us how brief has been our tenure of this terrestrial paradise, compared with its occupancy by the brutes that perish, the sidereal truths which we have been expounding impress upon us the no less humbling lesson that from the birth of man to the extinction of his race, the system to which he belongs will have described but an infinitesimal arc of that immeasurable cycle in which it is destined to revolve." §

Whilst, however, there is good reason to believe that the earth is certainly under the influence of these wider and more remote cycles, and that they produce some of those sudden changes in the atmosphere which baffle and confound the calculations of the meteorologist, they are too far removed from observation and too occult to be considered or taken into account here; and if we have referred to them, it is to show the difficulties which lie in the way of the student of this science, and of the professed adept, in

* The *annus magnus* of Plato is a period of 25,868 years, during which the equinoxes complete the series of retrogressions.

† G. Harvey, Esq., F.R.S.L., "Encyc. Metropolitana."

‡ Thomson's "Meteorology," Introd., p. 21.

§ Ibid.

reducing it to those fixed laws and rules which in other branches of physical science lead to certain results.

Meteorology was formerly made to include all the astronomical and atmospheric appearances of the heavens, but by a later and more logical arrangement, its meaning is restricted to the consideration of the phenomena of the weather, the seasons, and the climate; and these are viewed as referable to the investigation of those laws which "govern the ever-changing affections of the atmosphere of our globe in its relations to heat, moisture, and electricity, and the movements which the changes of those relations, brought about by astronomical or other causes, impress upon its parts.

The atmosphere, then, is both the medium and the cause of meteorological phenomena: the medium, because it is acted upon by the sidereal bodies with which the earth is surrounded; and the cause, in that it is of itself the origin of many of those phenomena affecting the state of the earth's surface. What, then, is the nature of that aerial fluid, which, whilst we cannot see it, is the element in and on which we live and breathe, whose influence we momentarily are sensible of, and whose modifications are the cause of the accesses of disease or the restoration of health on the one hand, and the sources of prosperity or of calamity to the cultivator of the earth on the other?

The atmosphere is composed of two aerial substances, or gases, namely, oxygen and nitrogen, in the proportions in volume of 20·8 of oxygen, to 79·2 of nitrogen. In addition to these there is a small portion (say 1 volume to 10,000 of air) of carbonic acid. These gases are only *mechanically* mixed, but they never vary in these proportions, and may be easily separated by analysis. Together, they form a ponderable body, capable of condensation, expansion, and mensuration. In addition to these natural components of the air, there are others of an adventitious character, which combine *chemically* with oxygen, and float about in variable quantities. Oxygen and hydrogen are thus found in combination, arising from manufactories, or from decayed vegetable substances. All these gaseous matters are elastic, clear, colourless, and devoid of taste or smell; but, in other respects, differ widely from each other in their nature and properties.

Oxygen is heavier than the air, its specific gravity being as 1·111 to 1·000. It is a supporter of combustion, and is essential to both animal and vegetable life. It is highly impressible, but the heaviest pressure will not liquefy it. It is an essential element of all organic substances, and constitutes 89 per cent. of water.

Nitrogen, or azote, is lighter than the atmosphere, being in specific gravity as ·9727 to 1·0. It neither supports combustion, nor will it sustain life of itself, but, with oxygen, enters into all the arrangements by which life is supported.

Carbonic acid gas is a colourless and inodorous fluid, and easily unites with water, to which it imparts a peculiar taste. To wine it adds a sparkling property, peculiarly observable in champagne. It is heavier than air, having a specific gravity of 1·52 to 1·0, and it can be poured from one vessel to another. Under a pressure of 36 atmospheres it liquefies at 32° Fahr., and when liberated in that state, so rapid is the evaporation, and intense the cold, that it assumes the solid form of snow, and remains congealed under the simple pressure of the atmosphere.

These, then, are the elements which form the atmosphere by which we are surrounded, and which is the basis of meteorological inquiry and investigation. It is upon it that the absence or presence of heat acts to produce those changes in the temperature observable from time to time, and it is the magazine, or storehouse, of those mists and vapours which, with the help of electric agency, form clouds and produce storms. The sun, as the centre of the system, is the primary agent in those changes which alternate with its relative position with the earth. Many of these are fixed and immutable, depending upon laws the operations of which are uniform and certain. Thus, "day and night, summer and winter, seed-time and harvest," succeed each other with unerring certainty. Others also, there is every reason to believe, depend upon fixed laws, but are at the same time subject to occult influences, which change their time and mode of operation, and occasion that perplexity and disappointment to which the cultivator of the ground is in an especial manner liable, and which so frequently baffle his most skilfully-arranged plans. It is to these latter that the science of agricultural meteorological investigation is directed, and although it were vain to expect to fathom all the depths of that system of nature by which the phenomena of the atmosphere are produced, we may, notwithstanding, by a careful observation of the changes that occur at certain seasons, and by a register of those changes for a series of years, be able to form a judgment, with some degree of certainty, of what will be the result of analogous states of the atmosphere.

The sun, as the centre of the planetary system, and the source of light and heat, is the most important agent in meteorology. Its action on water is different from that on land. It penetrates the former to a considerable depth, and is absorbed internally; but the rays that strike the land are absorbed superficially, or to a very minute depth from the surface. Water is a non-conductor of heat, and where it is received into its substance, it is only diffusible by agitation: and since this, however violent at the surface of the ocean, diminishes rapidly with the increase of depth, the progress of heat downward is a very slow process. Water gives out day and night radiant caloric, which is absorbed by the air, and raises its temperature. Much of the caloric so thrown off is balanced in the lower strata of the atmosphere; and, in the meanwhile, a balance is struck in the water itself of the quantities of heat received and parted with, by the preponderance of one or the other of what it gains or loses in average temperature in the twenty-four hours. Thus, in the warm season, when the days are long and the nights short, the general temperature of the sea slowly rises above its usual average, and *vice versâ* in the opposite season. Below a certain depth, however, the temperature of the sea would appear to be determined by other causes, and to be very little dependent on its superficial amount, or fluctuations. It has been found that the deep sea-water below a certain level, determined by the latitude, is of invariable temperature throughout the globe, and *that* a very low one—Kotzebue stating it at 36°, and Ross at 39° 5′, Fahr. The depth at which this fixed temperature is attained is about 7,200 feet at the equator, diminishing up to latitude 56° on either side that line, where it attains the surface, and the sea is of equal temperature at all seasons, and at all depths. Thence, again, the upper surface of this uniform substratum descends, and at 70° of latitude attains a depth of 4,500 feet. Thus the ocean is divided into three great regions—two polar basins, in which the surface of temperature is below 39°, and one medial zone above it, attaining 82° at the equator, and at the poles, of course, the freezing-point of sea-water. It is within these respective regions only that superficial currents can act as transporters of meteorological temperatures." *

In land there is neither agitation nor transparency, the communication of heat

* Herschel, "Encyc. Brit.," Art. METEOROLOGY.

downwards being entirely by conduction. It is absorbed by the surface, which receives and appropriates to a slight depth all the heat that in water would instantly be diffused through many yards of its substance. The superficial film then becomes heated, and, as it is a law of radiation that its intensity increases rapidly with the temperature of the radiant surface, it throws out on the instant a much larger portion of the solar heat than in the case of water, besides imparting to the air by contact, or communication, a proportionally greater amount. That portion of heat in the soil is conducted downwards; and so long as the surface is gaining in temperature, a wave of heat is continuously propagated downwards into the earth. When the surface, by the decline of the sun, begins to lose heat, this ceases, and (the radiation still continuing) a wave of cold (or less comparative heat) begins to be propagated, and so on alternately during the day and night. These waves, as they run on, spread forwards and backwards, and thus, by degrees, neutralise each other. Thus, the diurnal fluctuations of temperature beneath the surface grow continually less as the depth increases, the rate of the diminution depending upon the conductive capacity of the soil. In ordinary soils, the difference between the diurnal and nocturnal extremes becomes imperceptible at four feet below the surface. In like manner, the general increase of heat due to the summer season, and of cold during the winter, are propagated in similar but larger and feebler annual waves, which in their turn neutralise each other at more considerable depths, and become imperceptible at forty or fifty feet.

"It has been proved by the experiments of several meteorologists that there is a mutual interchange of heat taking place between bodies placed near each other, the hotter radiating more than the colder, in a ratio increasing with the increase of the temperature. Thus, when a hot body is placed in presence of other bodies, some colder and others hotter than itself, an equilibrium will rapidly take place, in which its momentary gains and losses of heat, to and fro amongst them all, will balance each other, and its temperature thenceforward will be unchanged." *

As the earth receives more slowly the heat of the sun than the atmosphere, so it retains it longer. In summer, the surface is hotter than the interior, but in winter the proportions are altered. Dr. Hale's experiments were very conclusive on this point. In August, 1724, when the thermometer in the air stood at 88°, and the surface was the same temperature, at only 2 inches below, the mercury fell to 85°, at 16 inches to 70°, and at 24 inches to 68°. The two last preserved the same temperature day and night, and fell to 63° at the end of the month. On the 26th October, when the thermometer fell to 35° 5′ in the air, at 2 inches below the surface it rose to 43° 85′, at 16 inches to 48° 8′, and at 24 inches to 50°. On the 1st November, when the air was at 27°, at 25 inches it stood at 43° 8′.

The process of evaporation of water takes place as well under one temperature as another, when exposed to the air. The miller well knows that in a long-continued frost his business is as much impeded by the decrease of the water as by the accumulation of ice; and the more severe the temperature, the greater the evaporation. In Tartary, the inhabitants avail themselves of this circumstance to reduce milk to a dry powder. They place the milk in the air in shallow pans, exposed to the east wind. After a little time, the frozen mass exhibits on the surface a dry white crust, which is the milk deprived by evaporation of the aqueous parts. This is scraped off carefully and put into bottles.

* Herschel, "Encyc. Brit.," Art. METEOROLOGY

Another crust then forms, which is scraped off in like manner; and so on, until the whole of the milk is reduced to a dry white powder, which, if preserved from the air, will keep for any length of time. A spoonful of this powder put into a dish of tea answers every purpose of milk or cream. Evaporation, however, is more palpable under heat than under cold; and also in windy than in calm weather, the generated vapour being removed as fast as it is produced, instead of its being submitted to the slower process of diffusion upwards; the amount of water evaporated being in proportion to the extent of the surface exposed to the air. It is therefore greater from a rough moist soil, or from plants wetted by rain, than from the surface of water, and from the latter when agitated by the wind, than when at rest.

Winds are therefore amongst the most immediate agents in meteorology, and exercise a powerful influence over the phenomena of heat and moisture, tempering and modifying the former, and exhausting the latter. The salutary influence of the "March winds" in drying up the moisture of the soil left by the rains and snows of the preceding months is well known to every farmer. Nor are they less conducive to the health of both man and beast (the rheumatics notwithstanding) in dispersing pestilential vapours, and other sources of epidemic disease, and preventing the accumulation of heat under the influence of the sun's rays. The winds also cause currents in the ocean, by which the heated waters under a tropical sun are conveyed northward to temper the cold of that region. Thus, the "gulf stream," which proceeds from the Gulf of Mexico, takes its course along the coast of North America towards the polar regions, and describing a crescent, comes round in an exhausted, but still, to a perceptible extent, thermal state to the coast of Ireland, and is lost on the south-west coast of England.

Although the winds are proverbially the most uncertain and erratic of the ordinary meteorological phenomena, and our knowledge of the precise laws by which they are governed very imperfect, yet, by tracing the connection of this subject with other branches of physics, science has thrown much light upon it, and naturalists have been enabled successfully to arrange and classify the various forms in which these meteors present themselves, so as to give each a definite character and status in meteorological nomenclature.

The cause of wind is the pressure or expansion of the air by heat, the variable distribution of which in the atmosphere incessantly affects its local density, and disturbs the balance of forces. Upon an accession of heat, an immediate ascentional movement takes place in the air, causing an overflow of its material above, and a relief of pressure below. This distension of the air is irregular in its operation, as local circumstances cause the heat to be greater in one place than in another. Whenever this takes place, a pressure and disturbance in the surrounding neighbourhood succeeds. Such is the explanation of the phenomenon of wind. If there was or could be an equality of heat over the face of the globe, or in certain zones of it, there could be no wind, because there would be no expansion of the air to disturb the equilibrium. The watery vapours arising from the surface of bodies of water are a secondary cause of winds. Being lighter than atmospheric air, they ascend, bearing with them a portion of caloric. This, on reaching a colder region of the air, is liberated, and the vapour becoming thereby condensed into water, a vacuum is created, into which the surrounding atmosphere rushes, and produces an agitation, or wind.

Mountainous countries are more liable to sudden storms or gusts of wind than level ones. Their elevated ridges cause an interruption to the general currents of the air. In some cases they give a permanent direction to the wind in ordinary seasons. Thus, in Ireland, where a mountain chain runs through the country from north to south, west and westerly winds prevail nine months of the year. The plains to the east of the mountain range possessing a warmer temperature than the mountains, it causes a rush of air from the colder region of the high ground, which produces the effect.

Local causes sometimes produce atmospheric disturbances in mountainous districts, "which," says Dr. Thomson, "it is difficult to account for satisfactorily." Such is the "Helm wind," at Cross Fell, in Cumberland—a meteorological phenomenon which occurs at uncertain times, between October and May, and which is thus described in a recent publication :—"When the atmosphere is perfectly calm, and scarcely a cloud is to be seen in the heavens, suddenly a range of clouds is formed, called 'the Helm,' extending along the top ridge of the mountain. Almost parallel with this another range of clouds is formed, called 'the Bar.' The first of these clouds is well defined on its western, and the other on its eastern, edge, and they unite together at their northern and southern extremities, enclosing between them an ellipsis, whose length varies from eight to thirty miles, and its breadth from half a mile to four or five miles, enclosing within its area the highest ridge of the mountain. Soon after the appearance of 'the Helm,' a storm of wind commences within the area between the two ranges of clouds, blowing generally due east and west, and with such force as to break and uproot trees, scatter the stacks of corn and hay, upset horses and carts, &c. This sometimes continues for nine consecutive days, and is accompanied with a noise resembling the sea in a violent storm, but is seldom attended with rain. No hypothesis has yet been offered that satisfactorily accounts for this phenomenon; but the most probable solution is, that the air from the Northumberland coast being cooled as it rises to the summit of the mountains, becomes condensed, and descends again by its own gravity with great force into the district at the western foot of the mountain."

Meteorologists have divided winds into three classes—namely, general, periodical, and variable winds. General or permanent winds blow nearly always in the same direction. Thus, in the Atlantic and Pacific Oceans, under the equator, the wind is almost constantly easterly as far as 28° on both sides of that line. More to the northward it blows generally between the north and east; and the further north we proceed, the more the north wind prevails. Beyond 28° south, the south and east winds predominate, and the farther to the southward we go, the more the wind comes in that direction. Between 28° and 40° south latitude, and between 30° west and 100° east longitude of London, the wind most frequently blows from north-west to south-west; and the outward-bound East India ships run down their eastings on the parallel of 36° south. These are well known as the *trade winds*. The *monsoons* are those winds which for six months, from April to September, blow from the southward over the Indian Ocean, between the parallels of 28° north and 28° south latitude, and between the eastern coast of Africa and the meridian that passes through the western part of Japan. The other six months, from October to March, inclusive, the winds in the northern parts of the Indian Ocean shift round and blow in the contrary direction from that they held in the former period. The change is preceded by calms, variable winds, and storms of thunder and rain.*

* Gregory.

In tropical countries, they have land and sea breezes alternately in the twenty-four hours. The cause of this is, that water being a better conductor of heat than land, is less variable in its temperature. In the day, the land becomes heated, which rarefies the air, and causes in the afternoon a rush of cool air to set in from the sea, in which the heat from the sun's rays is more dispersed than in the land, which retains a great portion of it on the surface. At night the land loses its surplus heat, while the sea retains its portion; the conditions, therefore, being reversed, towards morning a breeze springs up from the land towards the sea, which, retaining its heat, warms and rarefies the air, whilst that on the land is cooled and condensed.

We frequently see clouds moving contrary ways, which is generally a prelude to a thunder-storm. This is caused by the temporary disturbance or rarefaction of the upper current of air in a contrary direction from that of the lower. The higher we ascend, the greater is the force of the wind, until we get above the clouds, when we find it calm and serene. Below this, towards the surface, the currents are interrupted by rising grounds, causing eddies and rebounds. At times, however, the storms sweep down the slopes of the mountains and hills, carrying everything before them, and scattering devastation on the plains below. Narrow passages between hills are subject to strong winds, because both the density and swiftness of the currents of air are increased by its contraction. Large lofty buildings in a city, such as cathedrals and churches, which have open spaces around them, and are surrounded by houses, have the same effect. Thus, in St. Paul's Churchyard, in London, in whatever direction the wind blows, there is a strong current of air all round it, proceeding from the streets opening into it in the direction of the wind.

The hurricane is fortunately but little known in the British Isles; but yet instances of its appearance have occasionally occurred. On the 3rd September, 1658, there was one which was said by the faculty to have occasioned the death of Oliver Cromwell by the sudden change in the density of the atmosphere; and in 1756, a hurricane took place in Scotland which uprooted and destroyed the wood of Drumlanrig, in Dumfries-shire. In 1703 a hurricane, which was supposed to have originated in the forests of North America, crossed the Atlantic, and with increasing violence swept over Britain, France, Holland, Germany, Sweden, the Baltic, great part of Russia, and Tartary, losing itself in the North Sea. The destruction of property was beyond calculation, but in Britain alone it was estimated at four millions sterling. Twelve ships of the royal navy, with 1,600 men, and mounting upwards of 500 guns, were destroyed. A vast number of houses were blown down, and of lives lost. Amongst the latter was the Bishop of Bath and Wells, and his lady, and the sister of the Bishop of London, by the falling of chimneys. It was in this storm that the Eddystone Lighthouse was washed away, with the architect, Winstanley, who had been so confident of its power of resistance that he expressed a wish to be in it during the most violent storm that could possibly blow. A hurricane swept over Dublin in 1850, attended with a storm of thunder, lightning, and hail, such as was never before witnessed in that city. The lightning was one continued blaze of fire, and the hail, or rather pieces of ice, were as large as pigeons' eggs. In its course, it smashed the windows and conservatories as effectually as if they had been exposed to the discharge of a regiment of musketeers. An assessment of the damages was made by the police, ordered by the Lord Lieutenant, and was found to amount to £27,000. What was very remarkable is, that the north and the south portions of the city wholly escaped. In the house occupied by the writer, within two hundred yards of the course of the storm, two small panes of glass were broken, and a greenhouse entirely escaped. So strong was the wind, that a horse and cart, with a man in the latter, standing at a mill door, were lifted clear off the ground and blown over. The centre of the city, which was the course of the storm, from west to east, had the appearance of having been the scene of a street battle.

Hurricanes are ascribed to electric action, causing a refraction of the atmosphere, and thereby occasioning a vacuum, into which the air rushes from every side to restore the equilibrium, the intensity of the action being proportioned to the amount of the disturbance, and the rapidity with which the rarefaction of the atmosphere has been effected; but surely such an one as that of 1703, recorded as above, was of too vast a character to be the result of a local expansion of the air, however great it may have been. In the West Indies they occur more frequently than anywhere else, and are most destructive of both life and property

The phenomena of rain are well known by naturalists. Its components are oxygen and hydrogen, in the proportions of one of hydrogen to eight of oxygen *in weight*, or two of hydrogen and one of oxygen *in volume*, or measure. The quantity of rain-fall diminishes as we recede from the equator, and is therefore different in different countries. Within the tropics there is a dry and a rainy season, which succeed each other with great regularity, depending upon the sun's position and the course of the wind. The quantity of rain during the wet season is enormous. In Burmah, in India (latitude 26° 30′) 60 inches fell in July, 1825, and 43 inches the following month. At Bombay, 32 inches have fallen during the first twelve days of the rainy season. This is equal to the annual rain-fall in England. The heat of the climate in tropical countries renders these heavy falls necessary to vegetation, and at the same time, by the rapid evaporation of the excess of moisture, prevents the injurious effects it would otherwise produce. The cultivation of rice, the staff of life in India, depends upon the quantity of rain, and a failure of that crop is equal to a sentence of death to unnumbered multitudes.

In many parts of the globe, rain falls only at long intervals, sometimes of years. This is the case in Egypt and other parts of Africa, in Asia, and in South America. On the coast of Peru, in the latitude of the Chincha Isles, from whence the best Peruvian guano is procured, it is known not to have rained for seventeen years, and a shower of rain is quite an historical event with the natives. It is this absence of rain that preserves the best properties of the guano—the soluble salts, that would otherwise be washed away. In these rainless countries the sandy arid plains absorb the moisture of the atmosphere in passing over them, so that there is seldom or never an accumulation of clouds sufficient to produce rain.

There is a great difference of opinion amongst scientific men respecting the nature of the clouds, or rather their formation. Professor Johnstone acknowledges that whilst they are universally considered modified vapour in substance, the precise state in which they exist is the subject of discussion still. Some suppose that they consist of inconceivably minute particles, or globules, of water filled with air; others that they are composed of crystalline, snowy, or icy particles, loosely aggregated, and floating upon the denser air of the lower atmosphere. Dr. Thomson thinks both theories may be correct under the varied aspects the clouds assume under different conditions. "In summer," he says, "we walk through the mist of the valley, and its moisture feels cold and penetrating. After an ascent of an hour, we pass into the cloud that we have, perhaps, seen afar off, high above the mist, hanging on the mountain's side, and the sensation is the same. The mist seems a fallen cloud, the cloud an elevated mist."

Dr. Hutton's theory of rain is founded on the supposition that it results from the mingling together of great beds of air of unequal temperature, differently stored with moisture. To this it is objected, that "the quantity of moisture that can at any time be discharged by such an union of masses of air, is by far too small to account for the actual precipitations of humidity which take place; and the example of the mean temperature of the lowest atmospheric stratum may be referred to as a proof, that were it to discharge, as Leslie expresses it, by some internal change of its constitution, its whole store of moisture, not more than five inches of water would be deposited; and that the atmosphere must therefore deposit five or ten times as much humidity in the course of a year as it can at any one time hold in solution. But it should not be forgotten that since only a very minute portion of the vapour contained in any of the atmospheric columns is at any time separated from the air, precipitation and evaporation must rapidly succeed each other, and that hence moisture is in some degree restored as soon as it is discharged. In addition to this, it should be borne in mind that in the currents that exist at all times in the air, and that bring into union volumes of very different temperatures, we are by no means to calculate on the discharge of *one* atmospheric column alone. The atoms of air that have discharged their watery stores over a given spot pass on, and are succeeded by others resulting from another union, thus adding the humidity which they are capable of discharging to the rain which has before descended." *

As we have said before, no theories should be formed without due observation, and this must embrace not one country, or one season only, but countries under different latitudes, and observations taken for a series of years, in which the effect of temperature and geographical position, with all the natural atmospheric phenomena existing, are taken into account and registered. The amount, too, of evaporation, which differs so materially in different latitudes, and local circumstances of soil and climate, all have their influence on the formation of rain. This task is considered much more easy in the temperate regions than in the tropics. Thus, whilst on the Malabar coast the annual amount of rain in thirteen years varied from 93·85 inches in 1813, to 169·19 inches in 1819, whilst the range of temperature was only between 78° 56′ and 82° 25′, the amount of rain at Manchester in seventeen years varied only from 27·472 inches in 1803 to 40·285 inches in 1816, the temperature ranging from 45° 4′ to 49° 7′.

Local position and other circumstances concur to render a place or district subject to a greater rain-fall. Thus in Devon and Cornwall, where the north-east and north-west winds prevail, owing probably to the influence of the Atlantic Ocean, but which nevertheless possess a variable climate, rain is very frequent, according to the following rhymes in every one's mouth at Plymouth and Penzance—

"The south wind always brings wet weather;
The north wind, wet and cold together.
The west wind always brings us rain;
The east wind blows it back again.

If the sun in red should set,
The next day surely will be wet.
If the sun should set in gray,
The next will be a rainy day." †

* "Encyc. Metropolitana." † Ibid.

The influence of the ocean, in fact, upon the quantity of rain that falls in a country is admitted by all meteorologists, being proved by the observations of travellers. This, however, does not extend to mountainous countries, which are always more subject to humidity than plains. "Thus, at Kendal and Keswick the amounts of rain-fall are respectively 54 and 67·5 inches annually; whilst in many parts of the interior of England not much raised above the level of the sea, it does not exceed 25 inches. At Paris it is only 20 inches; at Geneva, 42·6 inches, and on the Great St. Bernard, 63·13 inches. The moon, also, is considered by meteorologists to exercise an influence over the atmosphere; and that changes from wet to dry weather occur at the changes of that luminary. Mr. Howard remarks, that when the moon has great south declination the rain with us is moderate in quantity; on the contrary, while she is crossing the equator towards these latitudes our rain increases. The greatest amount of rain falls with us in the week in which she has the greatest north declination; and during her return south the rain again becomes diminished to the minimum, and this holds good in very nearly the same proportions, both in extremely wet and dry seasons. The diminution of the pressure of the atmosphere caused by the attraction of the moon must be regarded as amongst the causes that determine the fall of rain."*

Snow is caused by the congelation of the vapour with which the atmosphere is charged, when the temperature sinks below the freezing point of 32°. The light particles of moisture are attracted around minute centres, and, the attraction being uniform on all sides, the most beautiful figures are thus formed, mathematically exact in their stellaric, rhomboidal, hexagonal, and other elegant patterns. After the snow has lain on the ground for a short time, it condenses, and assumes a more solid form of crystallisation. Its adhesive qualities are occasioned by its needley, crystalline texture, assisted by a portion of moisture which freezes and unites the flakes together.

The amount of snow-fall in England and Scotland is much less than formerly, owing to the extensive and more perfect cultivation of the soil, and especially drainage, which has raised the average temperature of the soil and climate. The beneficial influence of snow on the young wheat, and other autumnal sown plants, is well known, and arises both from the electricity with which it is charged, and from the effectual covering it affords to shield them from the severity of the frost. In Siberia the difference of temperature between the atmosphere and the ground under the snow is as much as 38° Fahr. In England it is in proportion to the intensity of the frost. The whiteness of snow is occasioned by the minuteness of the particles of which it is composed, and the reflection of its crystals that form the flakes. The *production* of snow, says Dr. Thomson, depends on the temperature of the atmosphere; its *quantity*, on the amount of evaporation; its beneficial influence on vegetation is in proportion to the regularity of its deposit and its depth.

In alpine countries there are large accumulations of snow, which at times overhang the slopes, and sometimes, becoming detached in heavy masses, roll down the mountain sides in avalanches, and overwhelm the villages below. Loosened by the concussion of a thunder-storm, or a change in the temperature, or by its own weight overbalancing itself, the mass rushes with irresistible impetus to the valleys, and bearing everything before it, involves in one common destruction houses, trees, corn, and haystacks, and frequently the inhabitants themselves, who are unable to make good their retreat from

* "Encyc. Metropolitana."

it in time. Instances have occurred in which travellers have lost their lives by an avalanche. This was the case with Dr. Hamel, a Russian traveller, who, with A. Henderson, of Liverpool, and J. Durnford, attempted the ascent of Mont Blanc, with eight guides. A thunder-storm came on as they were about to retire for the night at the Grand Mulets. They remained there two nights, and then attempted to proceed on their ascent; but, in climbing up the mountain side, an avalanche swept away the whole party, with three of the guides.

Hail is another form of congelation, produced by sudden and intense cold in a moist atmosphere. Hail-storms are more frequent in the day than in the night, and they seldom extend far. They generally accompany storms of thunder and lightning, and are, on that account, ascribed by Count Volta to an electric origin. Such storms in summer are frequently very destructive to the standing crops of corn, and we have known many farmers who have been entirely ruined by them. As there is now an insurance company which, at a small premium, insures the farmer against such calamities, it is their own fault if they suffer from them.

Professor Matteucci considers that hail is formed instantaneously in the atmosphere, a nucleus being first produced, and then, through a discharge of electricity, a further instantaneous condensation of the vaprous cloud ensues, by which an icy crust gathers around the frozen pellet. The size of the hailstones varies from that of duck-shot to a pigeon's, and even a hen's egg; and sometimes large masses of ice have fallen, of the same nature; but they can hardly be called hailstones, although consisting of concentric laminations of beautiful formation. The theory of Professor Matteucci is illustrated by Professor Stevelley by a reference to a mine at Chemnitz, in Hanover, where the drainage of water is effected by an engine, in which the air is heavily compressed. When this air is liberated, such is the intensity of the cold produced by its immediate expansion, that the water carried out with it falls from the machine in a shower of ice.*

Electricity is considered a modification of the same principle as light and heat, the two last being what may be termed its passive, the first its active and erratic, form. The subject of electricity is more than ever one of deep interest to the human race, whether it is considered in respect to its moral, social, physical, or political influence upon society. Of all the discoveries which science has made in philosophy, none have equalled, in the magnitude of its ultimate power over the destinies of empires, that of the application of the electric fluid—if fluid it be—to the purposes of telegraphic communications between one place or country and another. By it, a power the most mysterious—for we are absolutely ignorant of its nature—erratic, impalpable, and dangerous, has, by the aid of mechanical genius, been subdued and rendered, not merely harmless, but serviceable upon the grandest scale, to mankind.

The terrors with which the ancients invested the lightning's flash and the thunder's roll, were not alone the unfounded results of prejudice. Ignorant of the laws by which they were governed, and of the properties of the unseen but all-powerful agent, they saw its effects in the blasted oak, the shattered tower, the riven rock, and still worse, the instantaneous destruction of human life; and these effects they ascribed to the anger of the offended gods! To those who fell victims to that anger, were not accorded the rights of sepulture; and the places where they fell were fenced round, to prevent the unwary from approaching them. The eagle, the sea-calf, the laurel, and the white vine

* Thomson's "Introduction to Meteorology."

were considered certain protectors from its awful effects. Such was the theory of the ancients of lightning; but the thunder by which it was accompanied, was considered to be an entirely distinct, and a terrestrial emanation.

The mystery, in fact, in which, anciently, the electric fluid was involved, has never been, and probably never will be, solved. "We know not whether it is a material though subtile agent of independent existence, or a new arrangement of molecules; whether it is a fluid, or a simple principle in nature, which avails itself of the aid of both solids and fluids to effect its purposes." We speak of it as material, for want of a precise knowledge, and call it "*the electric fluid*, or *electricity*." It was first reduced to a system by Benjamin Franklin, who discovered the difference between *positive* and *negative* electricity; the former being its normal state, the latter its condition after undergoing friction. That it pervades the whole creation, as his hypothesis alleges, there is now no doubt; and that it enters into the very essence of vitality, both in the animal and vegetable creation—if it does not actually, of itself, constitute the element of vitality—there is also abundant proof. That lightning is the effect of electric action, is also universally known. This was first suggested by Gray, a Charterhouse pensioner, and a F.R.S., who, speaking of the imperfect electrical machine then in use, expressed a hope that a way might be found for collecting a larger quantity "of electric fire to increase the force of that power which, by several experiments, seems to be of the same nature with thunder and lightning."* The discovery of the Leyden jar soon after fulfilled this prophetic wish.

The subsequent experiments and discoveries of Franklin (1752) are well known. He sent an account of them to the Royal Society of London, and that of Paris, and both those learned bodies rejected the theory, and refused to receive the letters. But Priestley, in England, and Beccaria, in Italy, defended him; and, soon after, the Royal Society discovered its error, elected him a fellow, and awarded him a medal. "The fellowship," says Dr. Thomson, "conferred less honour upon *him*, than he did upon *it*. It may be forgotten, and the medal may moulder in darkness; but the name of Franklin will endure and beam with greater radiance in ages yet unborn, in proportion as this subject is studied, and new truths are unveiled. The time is on the wing when, *not only in India, but in Polynesia and Central Africa, the experiment of the electric kite will be familiarly known to every schoolboy, and the fame of Franklin be as wide as the world.*"

The effects of electricity on the human body, especially under the intense cold of northern or Alpine regions, are very curious. Thus, sparks are elicited, by friction, from the clothes; the hair stands upright; a buzzing noise proceeds from the fingers' ends, and a similar sound around the head; even flashes dart from the body, attended with a crackling sound. Hair appears to be a powerful generator of electricity. The sparks produced from a black cat's back, by stroking it in the dark, have amused most young persons. If, during a severe frost, you beat a person on the back with a lady's fur boa, and then apply your finger to the tip of his nose, a visible spark will be elicited. However futile and inconsequential such experiments may be thought, like Franklin's kite, they go far to establish a principle now beginning to assume, more than ever, a practical form—namely, that the animal frame is, in itself, *a galvanic battery*, through which, during life, a current of electricity is continually in motion; that upon the due proportion of this current depends the preservation of health; that its derangement, excess, or

* Thomson.

deficiency, produces disease in various shapes, according to the condition of the body in other respects; and that its stoppage is attended with instant death.

The velocity of lightning, like that of the electric telegraph, defies all calculation. The effect in either is instantaneous, the difference being that the latter is under the control of human science, whilst the former, though undoubtedly subject to fixed but unknown laws, acts apparently at random. The instantaneousness of action in the electric telegraph is one of the greatest mysteries in the combination of art with nature, and is wholly incapable of being explained. We know that if we lay a rope or wire of *any length* on the ground, and pull it at one end, we produce motion at the other end. This is perhaps the best illustration of the electric telegraph that can be adduced; but this is merely a *mechanical* action, and wholly different in *principle* from that of electricity, which produces the effect without any mechanical effort or agency beyond a manipulation to form the galvanic communication, totally inadequate of itself to the effect. Electricity is, of all the natural forces, the most prompt and powerful. Sound is a slow traveller; light, with its mild and beneficent influence, darts its rays with great velocity, but admits of calculation; caloric is local, and requires a combination with other matters to extend its influence: but electricity is *sui generis* in its mode of operation, and while it fills all space, and is closely allied to other natural forces, acts apparently independent of them all; and, with a presence as nearly approaching to ubiquity as anything in nature can exhibit, darts its influence thousands of miles in a point of time too small to be capable of notation.

Light, heat, and moisture, with electricity as a modified form of heat, are the elements of meteorological science, on which its data are founded, whilst the atmosphere is the medium or theatre in which its phenomena are stored and exhibited. It was impossible that these should escape the observation of thinking men in all ages of the world, and more especially those whose avocations led them to be much abroad, and whose operations were more immediately affected by the changes that are continually occurring in the weather. They have, therefore, by a careful observation of the various phases of the elements around them, and the influences of certain of the atmospheric phenomena—observed and carefully noted for a series of years—deduced certain rules by which they have regulated their proceedings, whether in the cultivation of the soil or other open-air employment. Before that science had discovered the composition of the atmosphere, and accounted for many of the phenomena connected with it, much of ignorance, superstition, and fancy was mixed up with these deductions, and many of the operations of nature, founded upon fixed laws, were viewed with fear and apprehension as indications of the wrath of heaven against mankind. But whatever may have been the views entertained in ancient times of the ever-changing aspects of the heavens, and the phenomena connected with them, in the present day the man of science, and especially the Christian philosopher, views their occurrence with very different feelings. Whilst he can sympathise with those who are suffering from the violent effects of storms and winds, in their local ravages upon property or life, he knows that they are beneficial to society at large; and that the same lightning which blasts the oak, devastates the dwelling, and strikes the passer-by with instant death, and the hurricane which overturns everything in its progress, burying the inhabitants in the ruins of their dwellings—that these awful visitations are the cause of saving hundreds of lives, by the dispersion of those deleterious gases which would otherwise accumulate and engender endemic and epidemic disease.

With the same philosophic eye he is led to view the more extended and occult phenomena, general in their operation, but less palpable in their beneficial influence. And thus, by induction, he is assured that the Great Creator has made nothing in vain—that all his works are perfect, and that what appears to our finite minds discrepant and injurious in the arrangements of his providence, are but parts of a system calculated at once to promote his own glory and the welfare of the beings He has created.

It now only remains for us to enumerate some of those signs in nature and art which indicate changes in the weather. For although we believe it to be impossible absolutely to foretell what is to be the state of the weather for a season or at a distant period, yet those who have directed their attention to the subject have been enabled to note certain circumstances in nature around them, which, without the aid of empiricism, are believed constantly to precede an alteration in the phenomena of the atmosphere.

We begin with the barometer, the use of which every farmer is, or ought to be, acquainted with. The height of the mercury in the tube measures the weight of the atmosphere, and in proportion to its rise or fall is the density of the air under which alterations of the weather are produced. These alterations are sometimes very frequent, referring rather to the present than to distant periods and changes. Very sudden alterations in the mercury indicate immediate, and frequently violent, changes in the weather; and if the fall is great, a storm is at hand. Dr. Arnott, in his "Elements of Physics," gives the following account of a storm:—"In a southern latitude the sun had just set, with a placid appearance closing a beautiful afternoon, and the usual mirth of the evening watch was proceeding, when the captain ordered to prepare with all haste for a storm. The barometer had begun to fall with fearful rapidity. As yet the oldest sailors had not perceived even a threatening in the sky, and were surprised at the extent and hurry of the preparations. But the required measures were not completed when a more awful hurricane broke upon them than the most experienced had ever braved. In that awful night, but for the little tube of mercury which had given the warning, neither the strength of the noble ship, nor the skill and energy of the commander, could have saved one man alive to tell the tale."

A high range of the mercury in winter indicates frost; if it continues to rise, we look for snow. If it falls, a thaw is at hand. An east wind causes a rise, and a west a fall, of the mercury. The higher this is, the higher also is the temperature, it being the density of the air by which the rise is effected, and the latent heat increased. With a low barometer and a cloudy sky, showers may be expected.

The Sun.—Before rain the sun appears dim, faint, and watery. If at rising it appears red or pale, and afterwards dark, or hid in a black cloud, rain follows. If the sunbeams appear before its rising, or a halo surrounds it in the morning, or it appears hollow, or is surrounded with red or black clouds at rising, or if its beams be faint or short or watery, rain usually follows. A clear and red setting, and a grey rising, are indications of fair weather.

The Moon.—If a circle appears about the moon, or the horns or cusps are short and blunt, it portends rain. If more circles appear, winds and tempest will follow. If the horns are blunt for two or three days after the change, rain may be expected for that quarter. If the moon is not visible for two or three days after a change, and the wind is blowing south, a rainy time succeeds. If the wind is south, and a halo surrounds the moon's disc, the next day will probably be wet. If distorted, broken, or mock moons appear, a tempest is near. A lunar halo indicates unsettled weather. If the disc is much enlarged, or is of an unusually red colour, or the cusps are sharp and blackish, wind will ensue. If clear and bright, and the spots are seen distinctly, fair weather is indicated.

THE STARS.—If the stars are clear and numerous, twinkling brightly, it indicates fair weather in summer, and frost in winter. If any of the larger stars appear to have a halo round them, or are larger to the eye than usual, or are dim, or their rays blunt, or if they are more numerous than is usual, rain will probably follow. If seen in apparent motion, it foretells wind.

TWILIGHT.—If the sun, at setting, assumes a purple hue, with a haziness in the horizon, the next day will be fine. If a pale yellow hue prevails towards the zenith, a change of weather will ensue.

CLOUDS.—*Cumulus* * clouds indicate great saturation in the atmosphere; and when they form freely on the horizon after the sun begins to heat the air, rain may be expected at, or soon after, noon.

When *cirro-cumulus* † clouds are in the upper strata of the atmosphere, and become dappled, but not dense enough to exclude a view of the sun or moon, they indicate rain.

Cirro-stratus ‡ clouds in the west foretell that a south wind is about to blow with violence.

Cirrus § clouds form at an immense height, and indicate fine weather.

If clouds fly here and there in the early part of the day, with a red colour, or of a leaden hue in the north-west, it portends wind. If at sunset they begin to disappear, and have their edges tinged with yellow, the weather will be fair and settled. In a clear evening, if small black clouds appear, or if black, blue, or greenish clouds appear near the sun at any time of the day, or the moon, at night, rain usually follows. If large black clouds come from the north, and appear whitish when nearer, and the weather is cold and dry, snow or hail will follow. If watery clouds appear on the tops of hills, it also indicates rain, as appears by the Cornish proverb, "When Hengsten is wrapped with a cloud, a shower follows soon after." If clouds appear to move towards the sun, it denotes wind and tempests. Also, if they appear suddenly towards the south or west, the air being otherwise free from clouds, a tempest is at hand.

WINDS.—If the wind whistles, or howls, or veers much about, rain follows. A heavy shower after a high wind has begun to blow indicates an approaching calm. If, in great rain, the wind rises or falls, it signifies that the rain is about to cease.

All winds blowing have a beneficial tendency in clearing the air of pestilential vapours, which, in a still, warm season, engender endemic and epidemic diseases. For this reason the south wind, which is usually warm and calm, is more unhealthy than any other, if it continues long. On the other hand, the north wind is injurious to persons subject to chronic disease, as cough, rheumatism, &c. As to the east wind, the proverb says—

"When the wind is in the east,
'Tis good for neither man nor beast."

The west winds are usually moist, mild, and healthy; but they are frequently very tempestuous. Most of the hurricanes on record in this country proceed from that quarter.

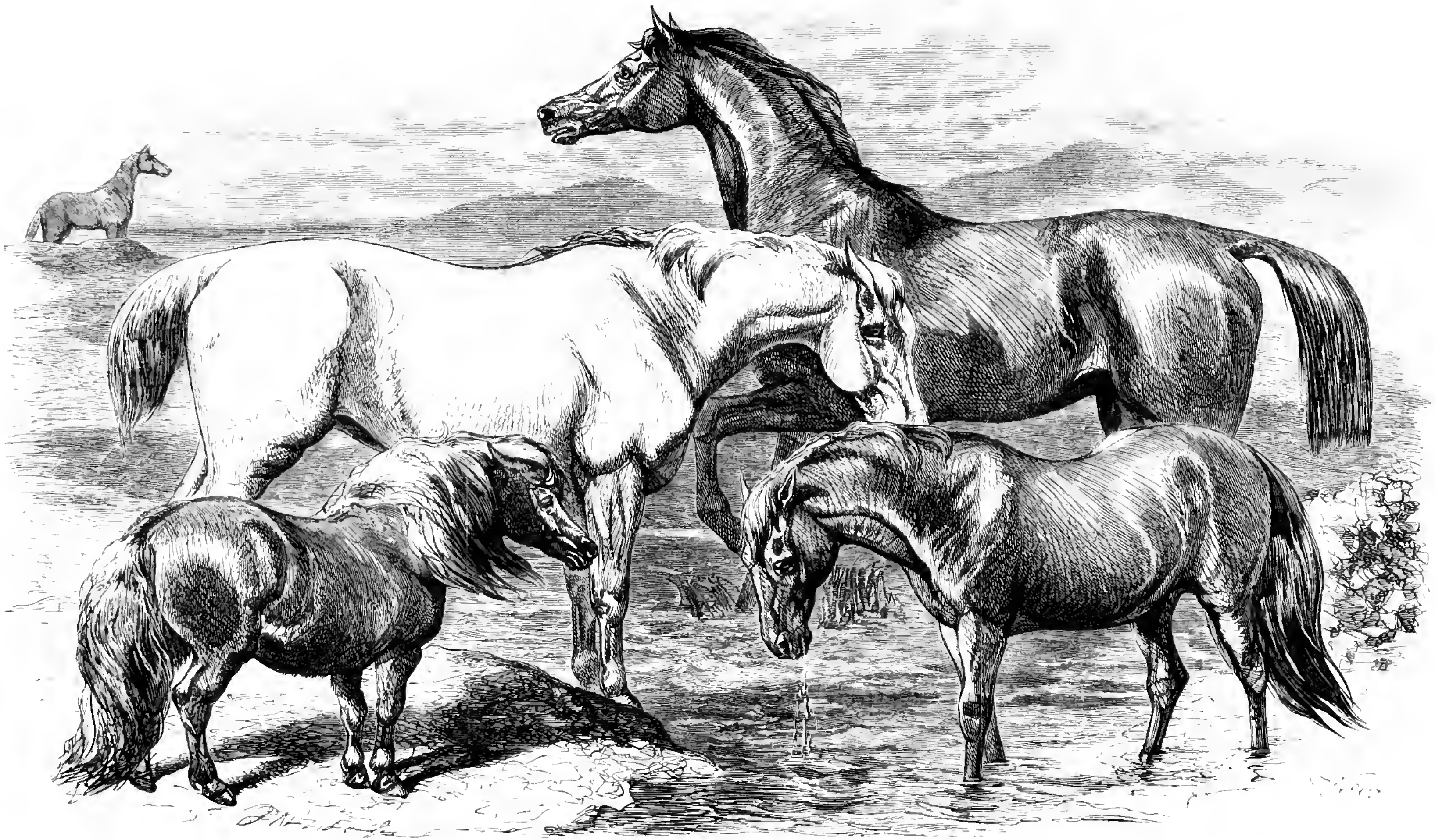
* Clouds having a flattened base, and a cumulated hemispherical structure.
† A flat cloud of great horizontal extension. It is called "the grey mare's tail."
‡ An orbicular mass of clouds arranged in extensive beds.
§ A curl cloud, resembling a distended lock of hair.

THE VEGETABLE KINGDOM.—The following plants shut the corolla on the approach of rain—scarlet pimpernel, common bindweed, red sandwort, speedwell, stitchwort, goats'-beard, gentianella, trefoil (the leaves), &c. &c.

ANIMALS.—When sea-fowls make for the land, it portends a storm. If land-birds become noisy and restless, rain follows. Flocks of rooks suddenly disappearing, single magpies seeking food, swallows flying low, a cock crowing and clapping his wings, the early note of several birds, moles throwing up the mould, cats washing their faces, dogs scraping the earth, or their hair having a strong scent, asses braying more than usual, cattle running about with their tails erect, kicking and flinging—all these are signs of rain. If swine run about squeaking, it portends windy weather; if they shake the straw in their mouths, rain follows. If ducks and geese pick their wings, wash themselves, or cackle more than usual, it signifies rain. Also earthworms coming to the surface, rats and mice running about in all directions, spiders disappearing, or dropping from their webs, bees hastening home, ants keeping within their hillocks, frogs and toads croaking, the leech ascending to the top of the water-bottle, gnats and flies biting sharper than usual—all these portend rain.

Fair weather is indicated by sea-birds leaving land, kites and swallows flying high, the songs of birds being loud, clear, and joyful, bats appearing early in the evening, gnats playing in the sunbeams, spiders active, glow-worms shining in the hedge-rows, the leech lying motionless at the bottom of the bottle, owls whooping at night, the raven or carrion-crow croaking clear, &c. &c.

The above indications refer to *immediate* changes of the weather, for hitherto all attempts to foretell more distant atmospheric phenomena have failed to a greater or less extent—certainly so as to neutralise whatever beneficial effect they might otherwise have. "Never," says Arago, "whatever may be the progress of science, will the *savan* who is conscientious and careful of his reputation speculate on a prediction of the weather." Sir D. Brewster also says, "In the very atmosphere in which he lives and breathes, and the phenomena of which he daily sees and feels, and describes and measures, the philosopher stands in acknowledged ignorance of the laws which govern it. He has ascertained, indeed, its extent, weight, and composition; but, though he has mastered the laws of heat and moisture, and studied the electric agencies which influence its condition, he cannot predict, or even approximate to a prediction, whether on the morrow the sun shall shine, or the rain fall, or the wind blow, or the lightning descend. 'The wind bloweth where it listeth, and thou hearest the sound thereof, but canst not tell whence it cometh or whither it goeth.'"



SHETLAND. ROADSTER. THOROUGHBRED. WELSH.

PART IV.—THE DOMESTIC ANIMALS.

SECTION I.

THE system commenced by Bakewell for the improvement of cattle and sheep has been followed up ever since with the most entire success, by its application to every description of domestic animals. Previous to his time it was an established maxim that to breed "in-and-in," that is, from animals near of kin to each other, was destructive of the more valuable qualities of a race, producing a general deterioration. This vulgar prejudice has been completely exploded by the admirable results of the opposite practice; and nearly a century's experience has established the law of nature, that to preserve the excellencies of a breed, it is only necessary to select the best types, and to adhere to them, whatever may be the relationship between the male and the female, and never to reject a good animal on that account. A change of stock by crossing can only be necessary when the one possessed exhibits defects that require to be removed; and then care should be taken to select an animal for the purpose with the requisite qualities to effect the object. This rule should be observed with every kind of domestic animal, on the principle that *only like can produce like*. There cannot be a stronger proof of the correctness of this rule than that of Bakewell himself, who for twenty years had not a cross in his flock from any other breed than his own; and that his best stock was bred from the nearest affinities, without any diminution of size or other deterioration, but, on the contrary, with a progressive state of improvement to the last.

It requires, however, a considerable amount of practical knowledge to be able to judge of the comparative qualities of different animals of the same kind; and this knowledge can only be acquired by the most sedulous and unremitting attention. To know, for instance, the best outward marks of a horse by which to judge of his suitability for the work for which he is designed, and the indications of disposition, temper, constitution, efficiency, and other qualifications, requires an acquaintance, we are tempted to say, with *phrenology,* as well as comparative anatomy; for assuredly there are features in a horse, as every one knows who is familiar with that animal, by which an adept can tell whether he is likely to prove a good-tempered, tractable, useful, and enduring animal, or the contrary. And in regard to neat cattle it is no small matter, in purchasing, either for breeding or fattening, to be able, by a few slight touches, to determine whether he will readily lay on fat and flesh on the best parts, and in the shortest space of time. Yet these arts, as they may be called, are essential parts of the business of breeders and graziers, as well as of butchers; and no stock-master ought to be ignorant of them. Many graziers possess the most perfect skill in thus judging and selecting the animals they are about to purchase, and decide with a promptness that appears indifference to the uninitiated bystander.

The rule adopted by Bakewell applies as well to the smaller and feathered denizens of the farm-yard as to the sheep and oxen. A spasmodic deviation from it was attempted, a few seasons back, by the introduction of those huge monstrosities the Cochin-China fowls, whose gaunt, clumsy, gigantic forms, and hideous attempts at crowing, were enough to frighten the modest occupants of an English *basse-cour* out of their propriety. The rage for these ugly foreigners has, we believe, nearly subsided, and people are at leisure to marvel at the infatuation which, a few years since, raised their price to that of a prize ox at the Smithfield Show.

SECTION II.

THE HORSE.

THIS animal holds the most distinguished place amongst the domestic tribes, and with good reason; for whether we consider him as administering to the business or the pleasures of life, we find him alternately the cheerful companion, the ever-ready servant, and the too-frequently unrequited slave, of man. Pity it is that so noble and generous a creature, whose services are so useful and pleasurable, whose affections are so easily gained, and whose evil habits are so promptly subdued by good treatment, should ever be subjected to the brutality of owners who, while they boast their humanity, sink themselves by their cruelty below the dumb animals they misuse and torture.

The only domestic animals which exceed the horse in swiftness are the greyhound and the fox-hound; whilst he excels every other in grandeur and elegance of form, and in proportion of parts. We must look for the native country of the horse in the plains that surround Mount Ararat, where the ark of Noah rested; but of the period when it was first appropriated to the use of man as a beast of burden, there is no record. We know that the patriarchs rode on asses, and that no mention of the horse is made in Scripture until upon the death of Jacob, when Joseph conveyed his remains to the Cave of Machpelah, in Canaan, and "there went up with him *both chariots and horsemen.*" * This was about 660 years after the Flood, and 1690 years before the birth of Christ. Whether

* Genesis l. 9.

the waggons sent to fetch the patriarch and his family to Egypt were drawn by horses or asses is uncertain, but the time intervening between the two events was so short that we may reasonably suppose horses were used on that occasion also. In all previous mention of domestic animals, while the ox, the sheep, the ass, and the camel are repeatedly named, the horse is never referred to; and it is therefore probable that none of the patriarchs possessed that animal. A modern writer makes the following observations on this subject:—

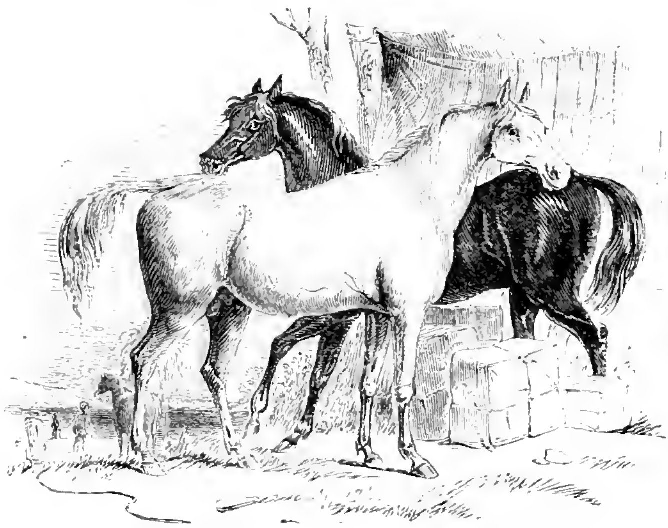
"The sacred volume, therefore, clears up a point on which no other record throws any light, namely, the period when the horse first became the servant of man, at least in one part of the world, and *that* the most advanced in civilisation, and before Greece was peopled. A long time must have elapsed before man was able to ascertain the value and peculiar use of the animals that surrounded him. He would begin with the more subordinate—those which were most easily caught, and most readily subdued; and the benefits which he derived from their labours would induce him to attempt the conquest of superior quadrupeds. In accordance with this, the writings of Moses show us that after the ox, the sheep, and the goat, man subdued the ass, and then the camel; and, last of all, the horse became his servant; and no sooner was *he* subdued, and his strength, docility, and sagacity appreciated, than the others were comparatively disregarded, except in Palestine, where the use of the horse was forbidden by divine authority, and on extensive and barren deserts, where he could not live."*

It would, therefore, appear from the above and subsequent passages of Scripture that Egypt took the lead in subduing the horse to the use of man. Six hundred years after Joseph's time, Solomon imported from Arabia spices, gold, and silver,† but horses for his chariots and cavalry were procured from Egypt.‡ It is, therefore, inferred that at this period, and long after, there were no horses in Arabia. In the second century of the Christian era the Egyptians sent presents of horses to monarchs of Arabia; and in the fourth century the Roman emperor sent 200 Cappadocian horses to a powerful Arab chief, as the most acceptable present he could offer. Three centuries after this the Arabs had very few horses, and those of an inferior description. They were obtained from Egypt, where they had probably been brought from the south-western parts of Asia, or from the interior, or northern, coasts of Africa. This, however, is mere conjecture. Certain it is that the Arabian horse of the present day is, with regard to his excellence, the creation of the wild Ishmaelite of the Desert, who, treating his horse as a part of his family, with a generous tenderness and consideration, has succeeded in preserving the fleetest and best types of that animal that are to be found in any part of the world.

* The Horse, "Lib. Useful Knowledge," p. 3.

† 2 Chronicles ix. 14.

‡ These horses cost Solomon 150 shekels of silver, or about £17 2*s.* of our money.



SECTION III.

THE ENGLISH HORSE.

The history of the British horse does not extend backward beyond the Roman conquest, but it is certain that at that period there was a powerful breed in use, as is proved by the desperate onslaught of the chariots of the Britons, armed with scythes fastened to the axle-trees. When the rough and heavy construction of the carriages and the badness of the roads—which were in the state in which nature left them—are taken into account, it is evident that the horses employed must have possessed considerable power, to produce so great terror in the Roman legions. Cæsar showed his appreciation of them by taking many of them to Rome as valuable acquisitions. It is added that British horses, like British slaves, were in great request in the Roman empire. When Cassivelaunus dismissed the main body of his army in Britain, he retained 4,000 war-chariots for the purpose of harassing the Roman foraging parties. It may be assumed from this circumstance that horses were very numerous in Britain at this period.

It was probably on this occasion that the British native horse was first crossed with a foreign one. After the establishment of the Romans in the island, they found it necessary to bring over a large body of cavalry, to establish a chain of posts, and to check the outbreaks of the natives. The horses thus introduced bred with the indigenous race, and beyond a doubt produced those varieties which were afterwards established in different districts, according as the nature of the country suited them. Nothing, however, appears in history respecting them for many centuries after the departure of the Romans from Britain; nor was it until the reign of Athelstane (924) that they are mentioned; when, after having reduced the Heptarchy to subjection, he was congratulated by some of the continental princes, and Hugh Capet of France solicited his sister in marriage, on which occasion he sent him, amongst other valuable presents, several German *running horses.* The character in other respects of these animals is no farther recorded; but it is probable that they produced another improvement on the heavy breed of native horses. Athelstane soon after made a decree that no horses should be exported for sale, but only as presents from the sovereign. In the year 1000 it was ordained that if a horse was lost or destroyed, the compensation awarded was £1 10*s.*; if a mare or colt, £1; a mule or young ass, 12*s.*; an ox, 2*s.* 6*d.*; a cow, 2*s.*; a pig, 8*d.*; and a man, £1. The buyer of a horse was allowed the following periods to ascertain whether he was free from certain diseases, namely, three nights to prove him for the staggers, three months to ascertain the soundness of his lungs, and a whole year to show him clear from glanders. For every blemish displayed within the allotted time after purchasing, one-third of the money was to be returned, except it should be a blemish of the ears or tail.

The use of horses in the plough is not mentioned until the tenth century, either amongst the Welsh or the Anglo-Saxons. But at the latter end of that century a law was passed in Wales forbidding the farmers to plough with horses, mares, or *cows,* but with oxen only. But in the time of William the Conqueror a piece of tapestry was woven at Bayonne, on which is the figure of a man driving a horse attached to a harrow. William's followers introduced both Spanish and Norman horses, and thus a new infusion of blood was thrown into the native breed.

The first Arabian horse on record was imported in the reign of Henry I. (A.D. 1121), by Alexander I. of Scotland, who presented it to the church of St. Andrew's, with costly trappings, Turkish armour, a valuable estate, and other property. In the reign of his son, Henry II., Smithfield had become a noted market for horses; and the manner in which the horses were tried by the purchasers is curiously recorded by Fitz-Stephen as follows:—"When a race is to be run by these sort of horses (*hackneys* and *charging steeds*), and perhaps by others, which also, in their kind, are strong and fleet, a shout is immediately raised, and the common horses are ordered to withdraw out of the way. Three jockeys, or sometimes only two, as the match is made, prepare themselves for thé contest. The horses for their part are not without emulation; they tremble and are impatient, and are continually in motion. At last, the signal once given, they start, devour the course, and hurry along with unremitting swiftness. The jockeys, inspired with the thought of applause, and the hope of victory, clap spurs to their willing horses, brandish their whips, and cheer them with their cries." This description, says the writer already referred to, reminds us of the more lengthened races of the present day, and proves the blood of the English horse even before the Eastern breed was tried.*

The Crusades did much to improve the breed of English horses. The days of chivalry were the days of excellence in horsemanship, as well as of feats of arms, and a Knight of the Cross would have been ashamed to appear before his mistress on an ignoble steed. Strong and powerful the horse must be to carry a tall man clad in complete armour of steel, besides the weight of his own mail, sometimes covering his whole body, and corresponding with that of his rider. Those who joined the Crusades, most of whom were wealthy persons, would avail themselves of the opportunity to obtain barbs or Arabian horses in the East. Richard Cœur-de-Lion purchased two at Cyprus, neither of which, as an old metrical romance states, would he have sold for

* "Youatt on the Horse," p. 24.

£1,000 in gold, for neither dromedary, war-horse, steed, Arabian, or camel could compete with them in swiftness.

King John imported 100 selected stallions from Flanders, for the improvement of agricultural or draught-horses. He also kept up a numerous and valuable stud, and received from the crown tenants horses of superior qualifications instead of money, for the renewal of grants, or in payment of forfeitures due to the crown. Edward II., in the beginning of the fourteenth century, imported thirty Lombard war-horses, and twelve heavy draught-horses. Edward III. paid 1,000 marks for fifty Spanish horses, which upon arrival cost that monarch £13 6*s*. 8*d*. each, or at least £160 of present money. At this time, so jealous was the king of his neighbour's participation in the benefit of this importation, that it was made felony to export horses from England to Scotland. The tyrannical prohibitions of this and the succeeding reigns failed to produce improvement in the breed, or to increase the number of good horses. When Queen Elizabeth raised an army to repel the invasion of Philip's invincible armada, she could find horses enough for only 3,000 cavalry in the whole kingdom, and those were not very superior, according to Blundeville, who speaks contemptuously of them. They were strong and sturdy enough, but more fit for the plough than the saddle. A few of a lighter kind showed blood, and were ridden eighty miles in a day.

In Elizabeth's reign regular races were established, first at Chester and Stamford, as well as in Smithfield Market; but the horses running were of no particular breed, and no regular course was marked out. The contest was more akin to the present steeple-chase, and was often, by appointment, pursued across the most difficult and dangerous parts of the country. Gambling had not then been introduced, but the prize at first was a wooden bell adorned with flowers; afterwards a silver one was given to "him who should run the best and farthest on Shrove Tuesday." From hence comes the phrase of "bearing away the bell." In James I.'s reign, horse-racing was more attended to, and brought under certain regulations. James himself was fond of the sport, but his matches were against time, and were rather a trial of the bottom and speed of the horse than a competitive run. He purchased an Arabian horse of a merchant named Markham, for which he paid 500 guineas—an enormous sum in those days.

Soon after this another Arabian or Turkish horse was imported, which the king also purchased of Mr. Place. It was a splendid animal, and was called "the White Turk." Soon after, Villiers, Duke of Buckingham, introduced the "Helmsley Turk," which was followed by the "Morocco Barb" of Fairfax; and from this period the commencement of the breed of real racers may be dated. Charles I. established periodical races in Hyde Park and at Newmarket, which were suspended for a time by the civil war and the monarch's downfall. Cromwell cultivated the breed of blood horses, of which he had a stud, but he did not patronise or renew the races. But at the Restoration, those at Newmarket were restored, and royal plates were given at the principal courses. Charles II. also deputed his Master of the Horse to go to the Levant to purchase Barbary and Turkish brood mares and stallions.

The reader will now be able to trace the present excellent breeds of horses of the United Kingdom to their origin. The infusion of Arabian and Barbary blood into the heavier horses of this country has produced a race which for speed and endurance are not equalled in the whole world. We speak this advisedly, for in Egypt, in a recent trial between English racers and some of the best Arabians that could be found to run against them, the latter were beaten hollow.* Crosses of the full-blood-horse with the heavier breed, in various degrees, have equally improved the hunter, the coach-horse, the hackney, and even the cart or draught-horse, rendering them more active, enduring, and, consequently, more useful. We shall now proceed to describe the different distinct breeds of horses of the United Kingdom.

SECTION IV.

THE RACE-HORSE.

In his treatise on cattle, Culley remarks that he declines saying anything about the breed of race-horses, first because he knew very little about them, and, secondly, because he thought farmers ought to have little more to do with them than occasionally improving the breed of their riding-horses by the admixture of a little blood. We fully agree with him in the second reason, being no advocates of the "turf," which in the present day (whatever it may have been in former times) has degenerated down to a gambling, swindling, fraudulent institution, with which few men of character or integrity care to have anything to do, in consequence of the villanous practices resorted to by persons of high, as well as of low, rank and station in life. Notwithstanding this, it would be a matter of regret if the breed of blood-horses were to suffer deterioration, were it only for their utility in the improvement of other breeds.

No certain data, we believe, exist pointing out the origin of the racer, it being lost, like others of our domestic questions, in the obscurity of those ages when literature was confined to the cloister, and the few historians who arose were occupied rather with political than social affairs. Amidst the confusion, too, attending the repeated invasions and civil wars which devastated the country at short intervals, and especially the suppression of the monasteries by the eighth Henry, a vast amount of both political and social records, bearing upon the domestic institutions and affairs of the country, must have been destroyed. It is believed that, after allowing for the numerous crosses with Arabian and Barbary horses that have been introduced, the basis of the breed of both race-horses and hunters is to be looked for in that powerful indigenous animal which so much excited both terror and admiration in the Roman legions, and which, as the trial in Egypt just referred to proves, has given the English full-blood-horse a preponderance of speed and "bottom" over every other in the known world. The "stud-book," which is a register of authority so far as it goes, traces back the pedigree of every racer of distinction, through sire and dam, to some Eastern origin, or until it is lost in the uncertainty of an early period of breeding. The pedigrees of all the present racers of note are referred ultimately to some well-known "turf-horse," and if an earlier deriva-

* It is very probable that this superiority of the English blood-horse over the Arabian, as shown in those trials, arises from climatic influences upon the constitution; and that the warm climate of Egypt is less favourable to the maintenance of strength and endurance than the comparatively colder one of the United Kingdom.

tion is required, it is continued through either the ancestral lineage of an Eastern horse, or is lost in obscurity.

Youatt remarks that "whatever may be the truth respecting the origin of the race-horse, the strictest attention has for the last fifty years been paid to pedigree. In the descent of almost every modern racer not the slightest flaw can be discovered; or when, with the splendid exception of Sampson and Bay-Malton, one drop of common blood has mixed with the pure stream, it has been immediately detected in the inferiority of form and deficiency of bottom; and it has required two or three generations to wipe away the stain and get rid of its consequences."* The same author says, "the racer is generally distinguished by his beautiful Arabian head; his fine, and finely-set-on neck; his oblique, lengthened shoulders; well-bent hind legs; his ample, muscular quarters; his flat forelegs, rather short from the knee downwards, although not so deep as they should be; and his long and elastic pastern."†

The best of the present racing stock trace back their pedigree to the Darley Arabian. This celebrated horse was bred in the Desert in the neighbourhood of Palmyra, and was purchased at Aleppo by a brother of Mr. Darley. His immediate descendants were the Devonshire or Flying Childers; the Bleeding or Bartlett's Childers; Almanzor, &c. The Flying Childers was so called from the name of his breeder, Mr. Childers, and his extraordinary swiftness, in which he excelled every other horse of his day. It is said that he had run nearly a mile in a minute, but he was known to have run over the round course at Newmarket, a distance of three miles, six furlongs, and ninety-three yards, in six minutes and forty seconds; and the Beacon course—four miles, one furlong, and one hundred and thirty-eight yards—in seven minutes and thirty seconds. Childers was first trained as a hunter, but the extraordinary speed and courage he displayed led to his introduction to the turf.‡ He was never exceeded in fleetness, unless it was by Firetail, who in 1772 ran a mile in one minute and four seconds, which is the greatest authenticated display of speed on record.

The celebrated horse Eclipse, so called from his being dropped during a total eclipse of the sun, which Lawrence says was so effective that the cocks and hens went to roost, was got by Marsk on Spiletta. The former traced his pedigree up to the White Turk, and other celebrated Arabians or Barbs. He is said to have covered eighty-three and a half feet every second of time when at the top of his speed; this was calculated to be about twenty-five feet at every stroke, and amounts to above fifty-seven miles per hour; but, of course, it was impossible for him to have sustained that rate of speed for an hour. Eclipse was bred by the Duke of Cumberland, and was purchased by Mr. Wildman after the duke's death for 75 guineas. Colonel O'Kelly purchased a share of him of Wildman, and afterwards, wishing to be his sole proprietor, gave Wildman £1,000 for his share in him. He was not allowed to run until he was five years old (May, 1769), when O'Kelly backed him freely on his first race. Some persons took upon them to watch some of his trials, and old Lawrence gives a curious account of his speed. "They were a little too late," he says, "but they found an old woman who gave them all the information they wanted. On inquiring whether she had seen a race, she replied she could not tell whether it was a race or not, but she had seen a horse

* Youatt, p. 44. † Ibid.

‡ The Flying Childers was the sire of King Herod, who was the sire of 497 winning horses, who won for their owners upwards of £200,000. Herod was the sire of High-flyer.

with white legs running away at a monstrous rate, and another horse a great way behind trying to run after him; but she was sure he never would catch the white-legged horse if he ran to the world's end."

Eclipse ran only seventeen months, for so superior was he to every horse brought against him, that in the end no horse dared to enter the course or compete with him. In October 1770 he finished his career by walking over the course at Newmarket for the King's Plate, after having won for O'Kelly £25,000.* After this he was employed as a stallion, and was the sire of 334 winning horses, who netted for their owners more than £160,000 exclusive of cups and plates. He died in 1789 at the age of twenty-five years.

The Godolphin Arabian was a remarkable instance of the vicissitudes attending the lives of other animals as well as man. He was found in the streets of Paris drawing a cart, and purchased by an Englishman who was no bad judge of horse-flesh. He presented him to Earl Godolphin, under whose fostering care he proved to be a beautiful and singularly-shaped Barb instead of Arabian, with a lofty and arched neck, a little sinking behind the shoulders, and a corresponding elevation of the spine towards the loins. He became the founder of the modern thorough-bred horses, and died in 1753 at the age of twenty-nine. A regular succession of celebrated racers have appeared, from the period to which the above named refers, but we believe that very few foreign blood-horses have of late years been imported, the English breeders considering that no further mixture of blood is required, and that no foreign horses can compete with their present race. The line of succession, or pedigree, is now so strictly kept up, that the origin of every race-horse is as well known as that of the families of our nobility.

Yonatt complains that the horses are put to work before their physical powers are matured, and that consequently many valuable animals are broken down by the time when they ought alone to be entered. He mentions the Flying Childers and Eclipse as examples of the contrary practice, neither of them being allowed to run before they were five years old. Many of the best horses, he says, are foundered and destroyed before they arrive at that age. This may be affirmed of other horses as well as race-horses. The hunter is frequently put to hard work at three years old, which is much before his bones and sinews can have attained that strength and solidity required in horses used in the chase.

It is generally allowed that the racer of the present day is very superior both in size and shape to that of a century ago. Out of 130 winners at that period only eighteen were 15 hands and upwards; but at present a winner below that height is rare. This increase in height is ascribed to the influence of the Godolphin Barb, whose stock was even higher than himself. The average at present is stated to be 15 hands 3 inches. The improvement in shape is chiefly in the length and slope of the shoulders, and of the arms and thighs, with an improvement in the shape of the head. Nor is the increase in strength and swiftness less remarkable. Several of our best stallions, however, have been exported to America, Australia, and other parts.

The eagerness displayed in some, probably most, full-blood horses in the race is extraordinary, and shows that they enter into the spirit of the game as heartily as the rider. The racer requires little or no stimulus to do his utmost, and is often too

* Kelly was once asked by a relation of the Duke of Bedford what price he would take for Eclipse; he replied, "*All Bedford Level would not purchase him*," of another person he asked £25,000 down, and an annuity of £500 a year.

cruelly urged by whip and spur, when it is impossible for him to make greater efforts. This is well commented on by Youatt. "Forester," says he, "will afford sufficient illustration of the natural emulation of the courser. He had won many a hardly-contested race. At length, overweighted and overmatched, the rally had commenced. His opponent, who had been waiting behind, was gaining upon him; he overtook him, and they continued quite close to within the distance. It was a point that could scarcely be decided; but Forester's strength was failing; he made one desperate plunge, seized his antagonist by the jaw to hold him back, and could scarce be forced to quit his hold. In like manner, a horse belonging to Mr. Quin in 1753, finding his adversary gradually passing him, seized him by the leg, and both riders were obliged to dismount in order to separate the animals. Let us here pause and ask, would the butcherly whipping and cutting which seem so often to form the necessary and expected conclusion of a race—the supposed display of skill of the rider—the exultation of the thoughtless or unfeeling spectator—would these have carried such horses over one additional inch of ground? . . . . The horse is as susceptible of pleasure and pain as ourselves; he was committed to us for our protection, and our use; he is a willing and devoted servant. Whence did we derive the right to abuse him? Many a race has been lost by the infliction of wanton cruelty."*

We recollect reading many years ago of a horse which had gained a race against another celebrated racer. His brute of an owner immediately offered a large bet that, within a short time, he would produce a *gelding* that would beat the same horse. The wager was accepted, and he instantly ordered the winning horse to be castrated. Before he had recovered the operation the time had expired and he ran, and won the bet, but he died before they could get him into the stable. No punishment could have been too severe for the scoundrel who perpetrated this mercenary piece of cruelty; but, of course, he was applauded on the turf as a clever fellow.

SECTION V.

THE HUNTER.

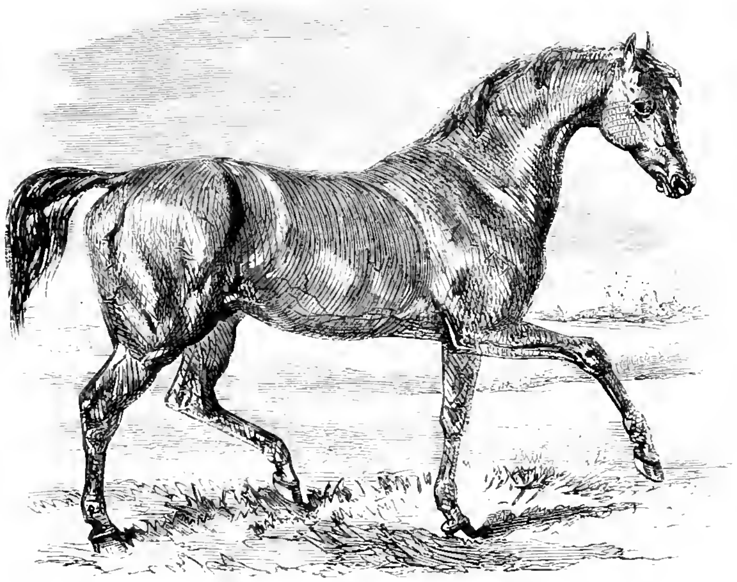
Most farmers are fond of field-sports, and many of them perhaps devote too much time and money in the pursuit of the fox or the hare. A hunter certainly ought not to be a part of the establishment of a mere tenant farmer, whatever may be said of him who farms his own property. Landlords have eyes and ears, and it is not every one such, however fond he may be of the sport, who likes to see his tenant "in at the death" before him.† But independent of this, is the expense involved in maintaining, not the

* Youatt, p. 49.

† A tenant of the late Duke of G. usually hunted with his Grace's hounds. He rode a splendid hunter, which his landlord so much admired that he deputed the huntsman to inquire his price. "Tell his Grace," said the young Nimrod, "that I like to ride a good horse as well as himself does." This imprudent speech was reported *verbatim et literatim*; and in two years after the young man was turned out of his farm.

hunter alone, but that of a round of convivial *after-meetings,* which it is almost impossible for a frequenter of the hunt to evade, if he wishes not to be thought mean and stingy. We have seen enough of the evil of a fondness for the sport to justify us in warning the young farmer against giving way to the passion, for such it is; and the most effectual way to avoid it is by not keeping a hunter. We have not referred to the loss of time and the neglect of business attending it, though these are no small evils; and when added to the more prominent ones should weigh greatly against yielding to the temptation beyond an occasional run with the hounds, which will involve neither disgrace, expense, nor much loss of time.

The work of an English hunter, and especially one possessed by the farmer, is not confined to the field; by his mixed origin he is equally at home in the carriage, on the road with the saddle, at the plough, or any other farm work, and no horse excels him; most of them are bred by the farmers themselves, or, at least, those who reside in a hunting country and occasionally follow the hounds. If they prove superior animals



THE HUNTER.

they are sold to the neighbouring gentry, or to dealers, who take them to the metropolis, where they fetch very high prices. The studs of the nobility are furnished from the same source. Most farmers ride well, and are thus qualified to train their young steeds to the chase. Many gentlemen ride thorough-bred horses in hunting; but, generally speaking, they do not possess bone and sinew enough to carry the weight—not regulated as in the race—or to stand the continuance of a protracted burst over a rough and stony country unscathed; although they may have spirit or bottom enough for any work. For this reason a half or three-quarter bred horse is mostly preferred. The hunter should not exceed sixteen, or be below fifteen hands high. Youatt thinks that as the cultivation of the land improves the speed of the chase increases, and therefore that a lighter kind of horse is required, because both the fox and deer, and consequently the hounds, increase their speed. In strong, thickly-enclosed countries the half-bred horse is most useful; but it is frequently difficult to lift such over a high fence, whether of stone or wood, whilst a three-quarter bred will take it at a flying leap if his rider has as much pluck as his horse. A *thorough bred* hunter who can carry twelve stone across country is worth at the present time from £250 to 400. The following are the characteristics of a good hunter as laid down by Youatt:—

'The first property of a good hunter is that he should be light in hand. For this purpose his head must be small, and his neck thin, and especially thin beneath; his crest firm and arched, and his jaws wide. The head will then be well set on; it will form that angle with the neck which gives a light and pleasant mouth.

"Somewhat of a ewe-neck, however it may lessen the beauty of a hunter, does not interfere with his speed, because, as is shown when the structure of the horse is considered, more weight may be thrown forward, and consequently the whole bulk of the animal more readily impelled; at the same time the head is more readily and perfectly extended, the wind-pipe is brought almost to a straight line from the lungs to the muzzle, and the breathing is freer. Should the courser, in consequence of this form of the neck, bear more heavily on the hand, the race is soon over; but the hunter may be our companion and our servant through a long day; and it is of essential consequence that he shall not too much annoy and tire us by the weight of his head and neck.

"The forehand shall be loftier than that of the racer. A turf horse may be forgiven if his hind quarters rise an inch or two above his fore ones. His principal power is wanted from behind, and the very lowness of the forehand may throw more weight in front, and cause the whole machine to be more easily moved. A lofty forehand, however, is indispensable in the hunter; the shoulder as extensive as in the racer, as oblique and somewhat thicker; the saddle will then be in its proper place, and will continue so however long may be the run.

"The barrel should be rounder to give greater room for the heart and lungs to play, and send more and purer blood to the larger frame of this horse; and especially more room to play when the run may continue unchecked for a time that begins to be distressing. A broad chest is an excellence in a hunter. In the violent and long-continued chase the respiration is exceedingly quickened, and abundantly more blood is hurried through the lungs in a given time than when the animal is at rest. There must be sufficient room for this or the horse will be blown, and possibly destroyed. The majority of the horses that perish in the field are narrow-chested.

"The arm should be as muscular as that of the courser, or even more so, for both strength and endurance are wanted. The leg should be deeper than that of the race-horse (broader, as you stand at the side of the horse), and especially beneath the knee. In proportion to the distance of the tendon from the cannon, or shank-bone, and more particularly just below the knee, is the mechanical advantage with which it acts. A racer may be tied beneath the knee without perfectly destroying his power, but a hunter with this defect will rarely have stoutness.

"The leg should be shorter. Higher action is required than in the racer, that the legs may be clearly and safely lifted over many an obstacle, and particularly that they may be well doubled up in the leap. The pasterns should be shorter, and less slanting, yet retaining considerable obliquity. The long pastern is useful by the yielding resistance which its elasticity affords, to break the concussion with which the race-horse, from his immense stride and speed, must come upon the ground; and the oblique direction of the different bones beautifully contributes to effect the same purpose. With this elasticity, however, a considerable degree of weakness is necessarily combined, and the race-horse frequently breaks down in the middle of his course. The hunter, from his different action, takes not this length of stride, and therefore wants not all this elastic mechanism; he more needs strength to support his own heavy carcase and the greater weight of his rider, and to undergo the fatigue of a long day. Some obliquity, however, he requires, otherwise the concussion even of his shorter gallop, and more particularly of his frequently tremendous leaps would inevitably lame him.

"The foot of the hunter is a most material point. It is of consequence in the racer, yet it is a notorious fact that many of our best thorough-bred horses have had very indifferent feet. The narrow contracted foot is the curse of much of the racing blood. The work of the racer, however, is all performed on the turf, and his bad feet may scarcely incommode him; but the foot of the hunter is battered over many a flinty road and stony field, and if not particularly good will soon be disabled and ruined.

"The position of the feet requires some attention in the hunter. They should, if possible, stand straight. If they turn a little outward there is no serious objection; but if they turn inward his action cannot be safe, particularly when he is fatigued or over-weighted.

"The body should be short and compact compared with that of the race-horse, that he may not in his gallop take too extended a stride. This would be a serious disadvantage in a long day and with a heavy rider, from the stress on the pasterns; and more serious when going over clayey poached ground during the winter months. The compact, short-strided horse will almost skim over the surface while the feet of the longer-reached animal will sink deep, and he will wear himself out by efforts to disengage himself. The loins should be broad, the quarters long, the thighs muscular, the hocks well bent, and well under the horse. The reader need not be told how essential temper and courage are. A hot irritable brute is a perfect nuisance, and the coward that will scarcely face the slightest fence exposes his owner to ridicule."

It is interesting to witness the enthusiasm with which the hunter engages in the burst with his rider. It is thus too with the race-horse, and with the charger accustomed to the evolutions of a field day at the sound of the trumpet.* Nor is this merely habit, but a real participation in the pleasure of the exercise. "It is beautiful to watch an old hunter," says Youatt, "who, after many a winter's hard work, is turned into the park to enjoy himself for life. His attitude and countenance when perchance he hears the distant cry of the dogs are a study. If he can, he will break his fence, and over hedge, and lane, and brook, follow the chase, and come in first at the death."

It is cruel in the extreme to urge so generous and willing a servant beyond his natural powers; and yet nothing is more common after a hard day's work in the field than to hear of horses that have died either in the field or soon after reaching the stable.

* About seventy years ago it was the custom in Norfolk for the farmers' wives to attend Norwich *Ped-market* themselves, with butter, eggs, fowls, and other provisions. One of these, the wife of a large occupier, who lived about three miles from the city, was jogging along, between a pair of panniers, on an old cavalry horse, who had never evinced any kind of vice to make him dangerous. But, lo! on this occasion, a corps of Yeomanry Cavalry were exercising in a field, near to which the lady had to pass. A charge was sounded; the old horse pricked up his ears, neighed vociferously, and, in spite of the lady's remonstrances, dashed into the field, and took his station in the ranks to the infinite amusement of the gentlemen soldiers, but the great annoyance of the fair equestrian, whose "smashed eggs bestrewed the way" by which her mad-brained steed had taken her. The writer knew the party well, and has frequently heard her son (one of the most respectable and successful of Norfolk farmers) relate the story.

In the case of a "hard run" with the king's stag-hounds, in which there was an uninterrupted burst of four hours and twenty minutes, one horse dropped dead in the field, another died before he could reach the stable, and seven more within a week afterwards."*

It is easy to perceive when a horse is distressed by over-work. He droops and staggers, his flanks heave, and he bears heavy on the hand, while a convulsive twitching of the muscles of the belly produces a peculiar noise, which might be mistaken for the beating of the heart; but this has almost ceased its action, and the lungs are gorged with blood, and the action of the belly is an effort of nature to supply the want of the proper circulation, but is too frequently in vain. In such a case the rider should instantly dismount, and, if he has a lancet or a pen-knife, take five or six quarts of blood to relieve the lungs. Then, if the horse is able to reach home, administer a powerful cordial, which, however objectionable in any ordinary cases, may be of essential service in one of exhaustion. Youatt mentions an instance of a favourite hunter, who after a "hard day" lay in the field stretched out and apparently dying. His owner procured a bottle of sherry, and poured the contents down the animal's throat. He immediately began to revive, and soon after got up, walked home and gradually recovered. A similar case of exhaustion, though not from the same cause, occurred with the writer. A fine young colt had been castrated, and the farrier in his haste had neglected to secure the ligaments on the vessels. The consequence was the bleeding commenced again, and on the writer entering the stable a short time after, he found the colt stretched at full length, unable to rise or notice him, and to all appearance at his last gasp. He instantly called in a veterinary surgeon, who administered half a pint of brandy after having secured the bleeding vessels. In less than a quarter of an hour the horse revived, and got on his legs; and although for a long time excessively weak, he perfectly recovered.

It is only in extreme cases like these that stimulants can be administered to horses with propriety, or even safety. Unaccustomed as these animals are to anything but the most inartificial food, any stimulant that increases the action of the heart and lungs is dangerous, and sometimes fatal. It is, therefore, at all times best, if practicable, to refer at once to a veterinary practitioner, who will judge without hesitation what is proper to be administered.

The hunting season over, the hunter that is not employed in other work may be turned into the pasture as soon as the weather is sufficiently warm to prevent all danger of taking cold. A shed should in such cases be provided for him to take shelter in bad weather, or in cold nights, if he is not near enough to the stable to have recourse to it, which would be the most eligible plan. Very frequently in May, and the beginning of June, the nights are as cold as in February; and to a horse that has stood in a warm or comfortable stable all the winter, it is dangerous to expose him altogether to the variable temperature of the open air day and night.

It is a question, however, whether under any circumstances a riding or carriage horse *in constant use* derives any benefit from being turned out of the stable for a "run at grass;" whether, on the contrary, he does not suffer in his efficiency, for the rest of the year by the injury he is likely, or liable, to sustain in his general health. If the season be moist the constant softness of the pasture is apt to produce thrushes. In very dry

* Youatt, p. 55.

weather the hoofs become brittle and rough, and it is difficult to keep them in an efficient working condition. On the other hand, for a horse accustomed to a dry and airy stable, where a moderate temperature is maintained day and night, and the food is adapted to the constitution and condition of the animal, to be turned into a pasture where he is exposed to excessive heat during the day, probably followed by a cold, chilling, and perhaps wet night, will have the same injurious effect upon his constitution as it would on that of a man. Both, in a physical point of view, are the creatures of circumstances; and such changes in the mode of living must necessarily be dangerous to either. It is the opinion of the most eminent veterinary surgeons that more horses have become roarers, broken-winded, and blind from being thus turned out of the stable than from any other cause. Inflammations are superinduced by the sudden changes of temperature, and from a dry to a moist state of the atmosphere. Mr. Percival, veterinary surgeon to the 1st Life Guards, in a work on the horse, has the following observations:—

"Take a horse fat and sleek in condition out of a warm stable where he has been well clothed and fed, turn him during the cold and wet of winter into a straw-yard, and go and look at him three months afterwards, and you will hardly recognise him. You will find him with a long, shaggy, staring coat, a belly double the size it was when in condition, and a skin sticking close and fast to his ribs, which may be readily counted with the hand, if not with the eye." He then compares this with the horse turned out to grass in the summer, and shows that the evils of the latter system are less remediable than those of the former. "The hide-bound horse may soon be restored by medicine and proper food; but the horse filled with green food has acquired a portion of loose fat, which must be reduced before he can be fit for work—it must be exchanged for better flesh, the produce of hay and corn; but the change is so great that it requires much care, and a long time, to bring him into an efficient state without injuring his constitution in other respects. The mode of life of riding and carriage horses is as artificial as that of a man, and, like his, has been so long practised, that it has become natural. As well might a man leave his comfortable house, and go to reside in a wood without shelter, as turn a horse out of a warm stable into a cold pasture with impunity to his constitution."

The training and preparation of a hunter for field work is, in some respects, similar to that employed in the case of the racer. All superfluous fat and flesh is got rid of by medicine and exercise; the latter also brings him into wind, gradually developing his power, without exhausting or overstraining him. A gallop of two or three miles is sufficient, with practice at the leaping-bar, gradually increased in height as the readiness and courage of the horse increases.* As the season approaches, Youatt advises that he

* It is wonderful what a space of ground some horses will cover at a bound when upon their full mettle. The late Earl of Leicester, when a young man, was hunting a stag that had been turned out of Melton Park, the seat of Sir Jacob Astley, in Norfolk. The stag, instead of taking to the fields, returned to the park followed by the hounds and horsemen. Mr. Coke was foremost on a splendid hunter. The stag dashed into the lake, and swam to an island at a distance of about thirty-six feet from the shore of the lake. The hounds followed, and Mr. Coke, without hesitating, clapped his spurs to his horse, and rode at the channel, which he cleared at a bound! Another instance is recorded that occurred near Bungay, in Suffolk. The road leading from that town to Mettingham Castle passes through a deep gulley, the sides of which were nearly perpendicular. On the occasion in question, the hounds were pursuing the fox, which, disappearing at the gulley, was soon seen on the other side. The dogs of course followed in full cry; but the horsemen! Only one of them attempted the dangerous leap; but this one, trusting to the courage and spirit of his hunter, rode at it at full speed, and cleared it—the most marvellous leap that was ever heard of, at least in that part of the country. The celebrated hunter Chandler and Proceed cleared respectively thirty-seven and thirty-nine feet, and they were thorough-bred horses.

should have two or three doses of physic administered and plenty of good hard food, with a daily gallop of a couple of miles at a moderate pace to bring him into wind. Air, exercise, and food are the grand agents in preparing the hunter for his work.

Generally speaking, those farmers who occasionally join the hunt, although they do not keep a regular hunter, manage to have a strong useful hack, or "servant-of-all-work," which will take a hedge or a gate, and keep up with the field with perhaps less appearance of distress than many of the professed hunters. It is possibly the same horse that he rides to market and about the farm, and is more exposed to the changes of the weather than the trained animal, and therefore takes less harm from the severity of a long run. Such horses, in fact, if well fed, will hold their wind quite as well as the best *menaged* horse in the meet.

SECTION VI.

THE HACKNEY, OR FARMER'S SADDLE-HORSE.

Although we have already, at the close of the last section, referred to this description of animal in connection with hunting, it is necessary to give further details respecting it. The hackney is of no particular breed, but is generally reared by the farmers themselves, or purchased by them of Yorkshire dealers. Vast numbers are bred in that county, and in Durham, Northumberland, and Lincolnshire by the farmers, who are all excellent judges of "horse-flesh." To be a Yorkshireman is, in fact, almost synonymous with being a proficient in equine affairs.

The hackney comprehends all horses fit for the saddle, between the hunter and the cart-horse. They are also employed in drawing light vehicles, and do not even disdain taking their turn in the plough when the weather of spring is fine, and business pressing; in fact, they are found to be better at this work than the heavier cart-horse, if the soil is not too strong, on account of their superior activity and spirit. A pair of them will with ease turn over an acre of mixed soil land in the day, and the writer has frequently had two acres of barley ploughed in on such a soil in the same time by a single light horse in a Norfolk wheel-plough. The road or the saddle is the sphere, however, for the hackney.

The best animals for the purposes of the farmer are those bred from a symmetrical and active cart mare and a well-knit half-bred horse, or even a three-quarter blood, if he possesses bone enough. With such a sire and dam he stands a good chance of producing a foal that, if carefully reared, will amply repay him for his trouble. It is considered good policy for a farmer to work mares rather than geldings, for not only can he breed from them, but they will do more work, taking bulk for bulk, being stronger and more enduring. A mare may also be worked gently almost up to the time of dropping her foal, nor need her holiday be a protracted one after that interesting event. She should be put to the horse early in the season, in order that she may foal at the least busy time of the year. No farmer ought to breed from an inferior mare, however good the horse may be he intends to give her. In fact, in nine cases out of ten, he cannot tell the quality, or the proportions and symmetry of a horse, because they are generally high-fed, and fattened up more like prize cattle than breeding ones. Much more depends on the character and qualifications of the mare than on those of the horse, for any chronic disease she may be the subject of, is very likely, if not certain, to be transmitted to her descendants.

Horses bred in the foregoing manner by the farmers, when well used, and not over, or too soon, worked, retain their full efficiency for many years, and in some cases, when they are old and seasoned, will perform prodigies of work. The late Mr. Loudon, butcher of Norwich, related to the writer the following circumstance. During the long war with France a contract for the supply of beef for the navy was issued, and many of the Norwich butchers sent in their proposals by the mail of the evening previous to the day appointed for receiving them in London. After the departure of the mail the competitors met, and, thinking themselves quite safe, began to talk freely of the terms they had sent up. Mr. Loudon found that he was a trifle above the lowest of the rest. He went home and inquired whether "the old mare" was in the stable? No; she was out at grass. He ordered her to be fetched home instantly, and to give her a feed of corn and a drink of water. He then sent for a lad who had been accustomed to ride the mare, and told him to dress himself in his best suit, to get some refreshment, and prepare himself for a journey, but to say nothing about it to any one. When the lad and the mare were ready, he astonished the former by telling him that he must ride to London that night, and arrive there early enough to deliver a packet which he gave him, at the address on it, *before twelve o'clock the next day;* that he was to keep a regular pace of eight miles an hour, and stop only long and often enough to avoid distressing the mare. The lad followed the instructions given him, arrived in London in ample time to execute the commission, which secured the contract for Mr. Loudon, and then leisurely returned to Norwich. The distance was 112 miles by the old road; and we feel pleasure in adding that the mare, who was fifteen years old, was never after put to any hard work, nor did she suffer at all from the exertion.

Many young horses are ruined by being ridden too fast at the beginning of a journey, and by injudicious riding on a journey. The pace should be regulated by the nature of the road over which he travels, according to the old adage:—

"Up the hill gallop me not;
Down the hill trot me not;
On the plain spare me not;
In the stable whip me not."

If the rules in the first three lines were strictly and generally attended to, horses would last many years, retaining their efficiency longer than they do. Exception must of course be made for post-horses, because travellers by post can seldom afford to spare the time a journey would take if the health of the horses was to be consulted. We believe that post and job masters generally calculate when purchasing a horse upon his lasting a certain number of years, according to his price, age, and constitution, they having no direct control over the post-boys they employ. These will at any time put their horses on full speed, if stimulated by the offer of a pint of beer and a half-crown from the traveller. Stage-coaches, too, formed another exception, but their days are over. Their last days, however, were their best, both for the horses and the travellers, for although they were driven sharp, the stages on most roads were not more than eight or ten miles, and the regular speed was ten miles an hour; but if a competition existed the rate was increased almost indefinitely. We recollect such a competition on the London and Colchester road, during which the distance—fifty-two miles—was accomplished in three hours and twenty minutes. On the Brighton and the Bath and Bristol roads, too, there was for a long time a desperate opposition, in which almost railroad speed was kept up, and passengers were sometimes taken *for nothing*, and given a dinner and a bottle of wine into the bargain! The horses worked in those days were frequently three-quarter blood, and stood the strain admirably, keeping at a canter the whole stage.*

The amount of work that a horse can perform for a continuance depends upon his constitution and what he has been accustomed to. His size, however, has something to do with it, for although many a fast trotting cob or hackney would beat a horse several hands higher in a short run, the latter covers so much more ground that if he has "bottom" he will be able to stand to his work longer than the other without injury. The writer once rode a blind mare twelve years old seventy miles in a day, out and home. He had never crossed her before, but had nothing to do but to guide her over the rough road, as she did not require either whip or spur, but went eight miles an hour, and never made a serious trip the whole journey. No young horse should be put to this utmost speed, or kept at work too long, even on particular occasions. We have known a three-year old horse injured for life, not by riding him too fast, but by continuing him on the road too long without rest. It went blind very soon after.

All saddle-horses should be exercised every day, for standing idle in the stable only for a few days is certain to injure his working condition. One week's superfluous rest will do mischief by shortening his wind, and so unfitting him for the road. It is the same with the horse as with the human species—regular, and not too violent, labour, or exercise, is the most conducive to the maintenance of health, efficiency, and the animal spirits.

In the stable the horse should have as much liberty as is consistent with his safety, and for this purpose a loose box or stall is the best, because his natural intelligence keeps him constantly on the *qui vive* as to what is taking place around him. Every noise, every movement of the groom, or other persons, attracts his attention, and he is kept in almost perpetual motion by his curiosity (if we may impute such a faculty

* There is no mode of travelling so exhilirating and delightful as that of sitting on the box with a coachman, behind four high-bred horses "in full feather," all in bright harness, the ribands held by an intelligent and educated driver (which was frequently the case), whose word of encouragement and a shake of the reins superseded the use of the whip, being all that was needed to put his cattle upon their mettle. Many noblemen and gentlemen did not disdain to take the ribands and drive a stage; we have sat behind Lord Charles Townshend, for instance, on a coach of which he was part proprietor. Railroads have now superseded all this; and it is quite true that the conditions of society are so changed the last thirty years, as to require thrice the speed, and a hundred times the accommodation for travelling that would be possible by the stage-coach system. Those, however, who remember this latter mode cannot but regret that the picturesque and the poetry of travelling should be thus wholly annihilated; but, as Bloomfield says, on another subject—

"The men of this *fast-going* ages
Do not wish these *slow coaches* to see:
To the bird that's inured to the cage,
It would not be bliss to be free."

Of course we do not now refer to those lumbering stages denominated "*the slow and dirty*," such as the "Old Yarmouth," driven by Lambert, who made a point of stopping at every public-house to "*moisten his clay*." The writer was once eighteen hours travelling eighty miles on that coach, there being no extraordinary delay on the road.

to him) to know what is going on. This activity of mind and body is also highly conducive to the preservation of his health and working conditions, and it is promoted by giving him a loose stall, in which he can move freely and exercise his inquisitive disposition at leisure. When fastened by a halter to his crib or manger his head is necessarily kept in a constrained posture, by which the sinews of the neck are prevented from having their full natural play. The circumstances occurring around him excite his attention, but he cannot move his head round beyond the length of his halter; and the only way in which he can express his fear or pleasure is by elevating his ears and pawing with his fore feet, and jostling about as far as the stall and the halter will admit. The extra room and expense of a loose box is not worth a thought in a farmer's establishment compared with the advantage and benefit accruing from it to the animal.

When coming off a journey it is a common practice for the groom (and we have known the master do it, too) to take a horse to the pond to wash the mud and dirt off his legs and belly. This cannot but be injurious to the animal's health when heated and in a state of perspiration, which renders him peculiarly susceptible of taking cold. If taken into the water at all, it certainly ought not to reach the knees, and the other parts must be cleaned from the mud by other means. That of washing it off is avowedly used to save the groom the trouble and labour of getting it off with a wisp of straw and a curry-comb. This latter operation is quite as efficient, and is, moreover, conducive to the health and comfort of the horse.

The custom of clipping the coats of saddle-horses was introduced about fifty years since; but Lawrence so strongly and successfully condemned it that most gentlemen abandoned it. Of late years, however, it has been resumed; but on what sound principle this unnatural custom can be justified, consistently with a regard to the health and comfort of the horses, we are at a loss to conceive.* The hair of an animal is given him not merely to act as a mechanical covering to protect him from the weather, but it is endowed with highly electrical properties, the action of which is essential to the well-being of the animal, and of itself assists in protecting it from the effects of weather. In proof of this fact, we find that in proportion as we recede from the tropical towards the polar regions every description of animal is clothed with a longer and thicker hair or fur. In the case of the polar elephant, now extinct, but of which some specimens have a few years since been discovered in a perfect state bound up in ice for ages, they were found to have three distinct coats of hair, the outer of which was a foot in length, the next a few inches, and the third a close, short, downy hair, well calculated to protect the body from the cold. The electric properties of hair and fur increase as we approach the polar regions, and are retained even after the skin is taken from the animal, as is proved by the experiment referred to in page 302. In our comparatively cold climate, therefore, if the hair of a horse is longer in winter than in summer it is because nature requires it to be so, to afford it protection from the increasing severity of the season, for which it is both chemically and mechanically so well adapted. It is thus an unnatural and dangerous practice to deprive the horse of his coat, and thereby expose him to every

* We are aware that Welsh and Lupton, in their treatise on "The Horse in the Stable," defend this practice, on the ground that it is conducive to the health of the animal, by preventing him from sweating when on the road, and contributing to his comfort in the stable. If a horse is properly groomed when he arrives off a journey his coat will soon dry without his being clipped or singed. We look upon clipping, therefore, as a substitute for grooming, or, in other words, to save a lazy groom some trouble.

injury that can arise from changes of temperature. From these the hair is designed to defend him, on the one hand by affording a mechanical protection against cold, and on the other, counteracting by the electric action the effects of moisture. If a horse is properly groomed in the stable his coat will never grow so long as to be unsightly; whilst to clip the hair from a horse that runs in a pasture, or is just taken into the stables, is in many cases equal to passing on him a sentence of death. We take care to put on additional clothing ourselves as the winter approaches, and we never shear our sheep until all danger from cold weather is over; and if nature increases the covering of the horse as the weather gets colder, we may rest assured it is not without sufficient reason.

It is a very common practice to stint a horse of water, but this is an error. If a horse has access to water at all times he will never drink more than will do him good. On this subject Lawrence, who knew *practically* more about horse-keeping than most men who keep them, makes the following sensible observations:—"I am not now so much among horses and grooms as formerly, but I remember that the old grooms, though so fond of *bub* themselves, were dreadfully alarmed lest their horses should be given to drinking, looking upon them as full brothers in blood to sheep and rabbits, and that water was, at best, but a necessary evil. Now, though I have had all sorts and descriptions of horses—lame, blind, broken-winded, glandered, &c.—I never stinted a horse of his water in my life, yet never experienced any ill consequences from such licence. The general notion that broken or thick-winded horses should be kept from drink, is to be attributed to their well-known greediness of it; and, after all, perhaps no horses have greater need of it. Excess in the case is clearly another thing; every one knows that a horse in a state of heat and perspiration must not be indulged with quantities of cold, or of *any* water; and the same rule holds previously to any great exertion; and should the animal be habitually too greedy of drink he should be restricted in quantity, and indulged more often." *

If allowed to help themselves to water, horses will never drink more than will do them good in the stable. We have known gentlemen who always allowed their horses to have a pail of water placed near the manger, that they might help themselves; and it was curious to see them, while eating, wash down their food with a sup of water, just as a man might do, without taking a long draught. A horse kept at dry food in a stable, is in the same condition as a man who lives on rich or high-seasoned dishes, and requires drink more frequently than when at grass, or when fed with green food in the stable; and the idea of rendering him more efficient for his work by stinting him of his water is contrary to nature. The exceptions stated by Lawrence are the only ones admissible in horse-keeping.

"The points of shape," says Youatt, "most essential to be attended to in the choice of a hackney or road-horse are, the shoulders and the fore legs and feet, because a horse whose shoulders are properly formed and placed is not liable to fall down, and because his soundness depends chiefly upon his legs and feet. The shoulders should not be too upright, but should slope backwards from the shoulder-point to the withers. It is desirable, if the horse is intended to carry a man of much weight, that the shoulders should be rather thick than thin; but it is essential that they should not be too large at the points. A horse whose shoulders are good, stands, when in a natural position, with

* "Lawrence on the Horse," p. 110.

his fore legs in a line perpendicular to the ground; it is, therefore, very desirable that the purchaser should see him in the stable, and before he has been moved, for he will then find him in his natural position, in which it may be difficult to place him after he has once been disturbed. Another mode of ascertaining whether the shoulders are properly placed, is by allowing the horse to walk past you, and to observe whether he places his fore foot more forward than the shoulder point when he puts it on the ground. A horse whose shoulder is properly formed will always do so; one whose shoulders are upright cannot. The fore quarters of a horse intended to be used as a hackney constitute an essential point; his carcase should be round and his ribs deep. A horse's fore leg of the proper form should be flat, and as large under the knee as it is just above the fetlock. The pastern should be so joined to the leg at the fetlock that the horse should neither turn his feet out or in; but it is less objectionable that a horse should turn his feet a little outward, provided it is not so much so as to hit his fetlocks, than that he should turn them inwards."*

In other respects the hackney should be a miniature of the hunter, except that his pasterns should not be so long or so oblique, and his form more compact, his height not exceeding fifteen hands and an inch. The foot is of great importance. If the shoe is worn at the toe, depend upon it he is a stumbler, but if he sets his foot flat on the ground he may be fully depended on for safety. If his knees are bent he will come down sooner or later, but most probably the former. The foot should be free from corns and thrushes, and this must be ascertained by testing it with the pincers; it should be open at the heel, and not too hollow or too flat. We close the account of the hackney with the following case by way of caution to purchasers.

The writer once purchased a fine five-year old Irish mare, about fifteen hands high, for a clerical friend. A trial in harness was given (the owner of the mare driving) which proved satisfactory, for her action was splendid, and she trotted twelve miles an hour. An examination by a surgeon was demanded, and the auctioneer, who was also of that profession, volunteered his services. The shoes were removed and hoofs examined, but in using the pincers it was noticed that the man omitted to press the side of one of the feet. The writer pointed this out to his friend, but he thought the character of the surgeon stood too high to allow him to practise an imposition. The mare was pronounced perfectly sound, and taken home. But on driving her out the next day she dropped on her knees, and became dead lame. It was then discovered that she had been at grass all the summer with thrushes of long standing, over which the hoofs had grown without their being healed, and that both the owner and the auctioneer were aware of it. Our friend threatened an action, but reflecting that probably the remedy would be worse than the disease, he pocketed the injury, and instead, bred from her a splendid foal by a pure Arabian horse, which made ample amends for the defects of the dam.

* Youatt, p. 32.

SECTION VII.

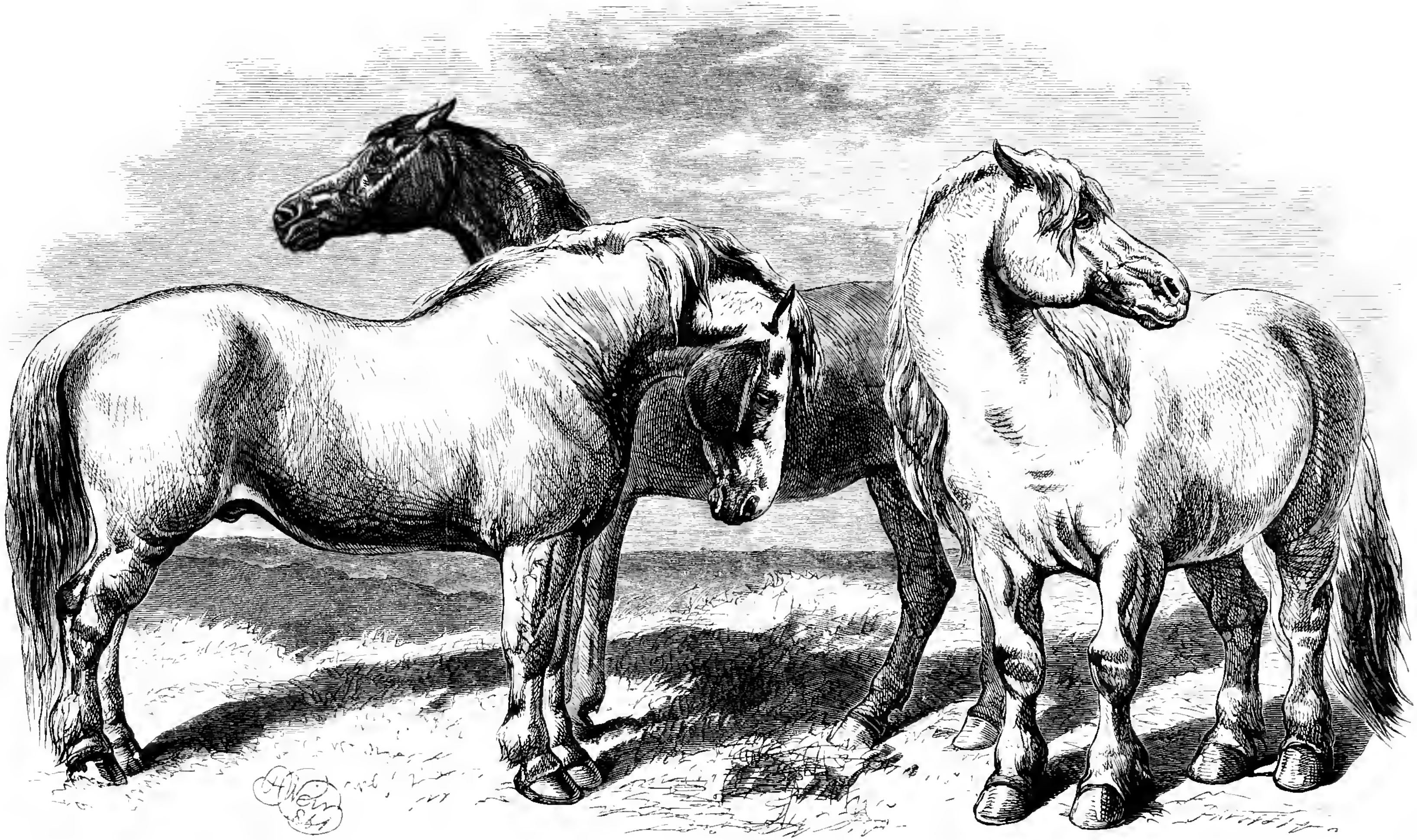
THE AGRICULTURAL OR CART-HORSE.

There are several breeds of heavy horses adapted to the farm, as the Cleveland, the Clydesdale, the old Suffolk Punch, and the heavy black breed. These we shall describe separately.

The "Cleveland bays" are chiefly bred in the counties of Durham, Northumberland, and York. They are remarkable for their strength, agility, and endurance, which render them very valuable in the collieries, where they are much employed. Culley affirms that three of them will carry a ton and a half of coals, travel sixty miles in twenty-four hours, without any other rest than two or three baits on the road, and frequently perform this task four times a week. Their symmetry is generally perfect; and it is very common to put the mares to a full-blood horse, the produce making first-rate hunters and saddle-horses. With a half-blood stallion they obtain capital carriage-horses or coachers. Large numbers of the Cleveland horses are brought to the fairs of Northallerton, Howden, and York; their colour, as the name indicates, is generally bay.

The Clydesdale horses are found pure in the district of Scotland bordering on the river Clyde, whence the name. This breed owes its origin to a cross of the Scotch mare and a Flanders stallion, of which six were brought over by the Duke of Hamilton about the beginning of the last century. The sires were all coach-horses, and the produce proved as good and useful for agricultural purposes as any British breed of horses. Their height is from fifteen to sixteen and a half hands, and they are generally strong, hardy, active, good-tempered, and remarkably steady in draught, and free from all vice. In colour they are black, grey, or brown. They are long in the body and legs, and are not remarkably handsome in shape. In John Lawrence's time the Clydesdale farmers used to dock them close, although that absurd and cruel practice was abandoned in every other part of the kingdom. The Clydesdale horses are larger than the Suffolk Punches, having a better head, a longer neck, a lighter carcase, and deeper legs, and are remarkably good plough-horses. Many of them are bred by a Clydesdale mare put to a half-blood horse. These are sold for coach or carriage-horses in the southern, as well as the central, counties of England. Put to a full-blood stallion the mares breed excellent hunters and saddle-horses.

The Suffolk Punch is at the present time more generally in favour than at any former period, and some valuable types of the breed have of late years been exhibited at the Royal Agricultural and other cattle shows throughout the kingdom. The old breed, which is not quite extinct, was remarkable for activity and determined perseverance at a dead pull; and it is said that a Suffolk Punch would strain at it till he dropped rather than give in. The present breed is the produce of a Norman stallion by the old Suffolk mare. Their colour is generally sorrel, but sometimes bay or chestnut. Some of them are a cross of a Yorkshire half-bred horse. More attention has been paid of late years in Suffolk to the selection of brood mares of the native stock, and the result is that the symmetry of the present horses is much finer than formerly, and as draught animals they are perhaps as handsome as any breed extant. It is well known that in Suffolk and Norfolk, where the Suffolk horses are reared and employed, the farmers plough more

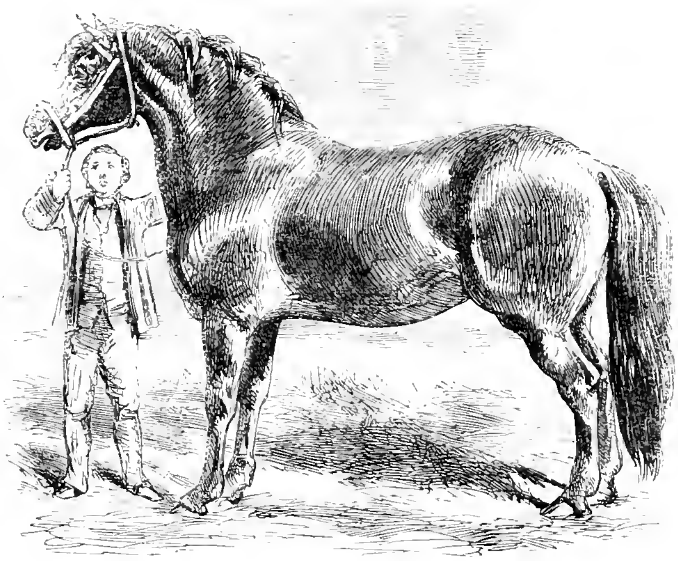


CLYDESDALE. CLEVELAND. FLEMISH.

land in a day than any other county. They were introduced into Scotland by the Earl of Hopetoun about seventy years since, and were much approved then.

"It was beautiful," says Youatt, "to see a team of true Suffolks, at a signal from the driver, and without the whip, down on their knees in a moment, and drag everything before them. Brutal wagers were frequently laid as to their powers in this respect, and many a good team was injured and ruined." The immense power of the Suffolk Punch is accounted for by the low position of the shoulder which enables him to throw so much of his weight into the collar. The old Suffolk Punch stood fifteen or sixteen hands high, had a large head, low shoulders, wide ears, coarse muzzle, a long and straight back, flat sides, hind quarters rather high at the hips, legs round, pasterns short, a deep carcase, and a full flank. The present breed is much handsomer, and at the same time possesses the same qualities of activity, endurance, and power to stand a long and severe day's work without being distressed. Some of the Suffolk entire horses have sold at very high prices of late years, the native breeders having devoted much time, attention, and money to their improvement. At many of the cattle shows these horses have carried off the prizes.

The heavy black horses are principally bred in the midland counties, and are purchased at two years old by the dealers from Surrey, Sussex, and Berkshire, who re-sell them to the farmers, by whom they are worked moderately until four years, so as to pay for their keeping. They are then sent to the London market, and sold at a large profit.



THE CART-HORSE.

Leicester, Warwick, Stafford, and Derby are the principal counties in which they are bred; and in these parts the farmers all use mares in husbandry. They are put to the horse in the spring, and the males are all reared to be disposed of as aforesaid, and supply the army and the London carmen; the largest and heaviest being selected for the brewers' drays, for which, by their weight, they are admirably adapted. A great number are bought by the farmers of the southern counties for plough and waggon-horses, only a few being reserved (with all the mare foals) as stallions.

"The vanity of many of the farmers in the south," says Culley, "in regard to their teams is most extraordinary. I have in Berkshire, and that neighbourhood, several times met a narrow-wheeled waggon with six stallions, one before another, the first horse, besides having on a huge bridle, covered with fringe and tassels enough to half-load a common Yorkshire cart-horse, has six bells hung to it, the next five, and so on to the last, which has only one; and it is really diverting to see with what a conceited air the driver struts and brandishes his long whip; a strange contrast this with the poor Highlander carting home his peat for winter fuel, when frequently both horse and cart are not of the same value as the harness used to a Berkshire waggon-horse. The reader will not be surprised when I tell him that I have many times seen in Scotland a horse and cart conveying peats, or turves, when the whole apparatus contained neither iron, leather, nor hemp. The collar or braham was made of straw, the back-band of plaited rushes, and the wheels of wood only, without bush of metal or binding of iron."

The black cart-horse was derived from a Flemish cross, the originals being introduced by one of the Earls of Huntingdon, who was ambassador to the States-General, and brought over a set of coach-horses of the black breed. These being mostly stallions, the farmers were induced to put their mares to them, and the cross succeeded and was perpetuated. Bakewell imported half-a-dozen Flanders mares, which were found useful in improving the Leicester black breed, but they were considered too heavy for carriage-horses, for which a lighter bay began to be substituted; and in the present day, with the improved roads which have been made throughout the country, a heavy horse is not required in harness. We question whether Culley, if he were living, would now be able to find in Berkshire a team of six entire horses as described by him. At the same time we should greatly regret that the pride which the waggoner of that county displayed in his team, and which is common to all teamsters who are worth their salt, should be lost. Woe to the farmer whose waggoner takes no interest in the condition and health of his horses!

The weight that the dray-horses of the London brewers will draw is enormous. The largest of them are bred in Lincolnshire, the fens of which appear to be adapted to their constitutions. Some of them stand seventeen hands high at two and a half years old. They have a broad chest, a thick upright shoulder (the more upright the collar stands the better), a low forehead, a deep round barrel, broad and high loins, ample quarters, thick fore-arms and thighs, short hairy legs, round hoofs, broad at the heels, and soles not too flat. The head of the dray-horse is fiddle-shaped, and indicative of anything rather than of superior intelligence or playfulness,* yet instances occur in which their equality to other breeds in this respect is evinced. We are often surprised at the exactness with which these huge animals, with a ponderous load behind them, will draw it within an inch of other and lighter vehicles, which are never touched; and this without the smallest intervention of the driver. These horses are purchased by the farmers

* An amusing instance of practical joking in a dray-horse occurred some years since in the yard of Messrs. Meux and Co., brewers, of London. There was in the brewhouse-yard a particular breed of pigs, to which one of the dray-horses took a great dislike, which he displayed in a ludicrous way. He would drop some oats out of his mouth, and when one of these pigs approached him to pick them up, he would seize it by the neck with his teeth, and souse it into the large water-trough set there for the use of the horses. He would then with the greatest glee caper about, shaking his clumsy head, and exhibiting all the signs of exultation at the feat. This was so often repeated, that when a pig was heard squalling, the men would exclaim "There's that —— horse at it again!" and would run to extricate poor piggy from his otherwise watery grave.

round London from the Lincolnshire breeders at about £10 each; and after working them gently, and feeding them highly, for two years, they obtain in London from £70 to £120 for them, according to their size and condition. Many of the lighter of the black breed are purchased for the cavalry, but as the government price is limited from £24 to £35 it certainly is not the best types of the race that are disposed of in this way.

As farm horses the black horse is not considered equal to the Clydesdale, the Cleveland, or the Suffolk, either in agility or endurance. Culley says that when put past their own pace they grease, and frequently go blind. They are, therefore, better adapted to the slow dray and heavy waggon work than to the light operations of the farm, which are performed admirably by the other breeds and their crosses. A good many black horses are still imported from Flanders for the use of undertakers. These are remarkable for the sleekness of their jet-black coats, their flowing manes and tails, and for their symmetrically-proportioned shape. Her Majesty the Queen has a stud of them which are driven in the royal carriage when her Majesty goes to open Parliament. The black horses are much less used by the London carmen now than they formerly were, for however powerful they may be where weight must be opposed to weight, their slow rate of two or two and a half miles per hour is inconsistent with the despatch which is now required in the streets of London and its suburbs, where so many obstructions interfere with progress. Many of the carmen, who are now accommodated with an elevated seat, and drive with reins, go at the rate of five or six miles an hour in a clear road, the frequent delays rendering it necessary.

SECTION VIII.

THE IRISH HORSE.

The Irish hunter is remarkably fine about the head, but is rather too narrow across the forehead. His muzzle is small, but his nostrils are wide, his jaws open, and head well set on; his shoulders are particularly sloping and powerful; his body is well ribbed up, but slightly flat; hips wide and powerful, the loins also being muscular and well united to the back; the croup is almost always sloping, and the tail set on low; legs and feet clean and sound. The great fault of the Irish horse is his temper, which is frequently obstinate and fractious, but his constitution is good, and he can endure hard work without flinching far better than a larger animal, for he is generally smaller than the English horse.

A great deal of pains have been taken of late years to improve the breed of Irish hunters by crossing the Irish mare with a full-blood English stallion. By this means they obtain a much better type that can stand more cross country work, while it retains its admirable native tact in leaping the stone walls and the many rivulets with which the country abounds. The manner in which an Irish horse takes a wall or a hedge is peculiar; he does not cover either at a bound like the English horse, but touches the top with his hind feet like a greyhound, and takes a second spring. Many of the Irish nobility and gentry have excellent studs, both of racers and hunters. The work of the latter is far more severe in Ireland than it is in England, on account of the stone walls, some of them six feet high, which few English horses would attempt, but which the Irish horse will go at without flinching. Frequently, too, there is a wide ditch on the other side, which can only be covered by the method referred to, of the horse taking a fresh purchase from the top of the wall. The country also is much more irregular, and roughly intersected with wide ditches and rivulets, which keep the hunters in constant practice, so that they become exceedingly expert. Their leaping is rather the jump of the deer than the strain of the English hunter

The Irish car-horse is a small, active, and enduring animal, and will travel ten or twelve miles an hour with an "outside car" without being distressed. They are seldom more than fourteen hands in height, and are mostly cross made, but this does not appear to lessen their utility; they are much used in agriculture, and will bring twelve or fifteen hundredweight of hay many miles in the one-horse cars of the country. It is a curious sight to see a dozen of these cars, all loaded with loose hay (they never *truss* it in Ireland), coming along the road in a close line, like an elongated haystack, the horses being quite hidden with the sprawling loads they are drawing. Their greatest fault is a hot, skittish temper, of which the writer has had some experience in Ireland, having purchased several there for his own use; but he never had one that could not be overcome by gentle usage.

Most of the horses used in agriculture by the peasantry of Ireland are, like the owners, very poor and half-starved, but in other respects they are well treated by them, and, as is the case with all animals, they are considered as part and parcel of the family. It is very seldom you see an Irish carman or farmer use a horse in the brutal manner that is so common among the lower class of horse-keepers in England.

SECTION IX.

GALLOWAY, COB, AND PONY.

The first of these, the Galloway, was once the common horse of all work in the south of Scotland, but he is now extinct, being probably merged, in the improvement of agriculture, into the large breed obtained by crossing with the Clydesdale and other horses. It is generally thought in Scotland that the Galloway breed owed its origin to a cross with the Spanish horses brought over to that country by the Invincible Armada, part of which was wrecked on the rocky coast. They were a hardy, active, and docile race, and it is to be regretted that they have been lost.

The Galloway stood about fourteen hands high, and his powers of endurance, as recorded in particular instances, are wonderful. In the year 1814 one of these little animals started from London the same time as the Exeter mail, and keeping ahead of it throughout the whole journey of 172 miles, arrived at Exeter a quarter of an hour before it. Youatt, from whom we quote, adds, "We saw him about a twelvemonth afterwards, wind-galled, spavined, ring-bound, and a lamentable picture of the ingratitude of some human brutes towards a willing and faithful servant." *

The cob may be said to have taken the place of the Galloway, although it is of no particular breed, but rather the diminutive of other breeds. He is in general thick and strongly built, about fourteen hands high, and able to carry from fifteen to twenty stone. His make is that of a small cart-horse, compact, and active, with bones as large as in that breed. Their existence is accidental, and they are neither more nor less than dwarfs of the breeds from which they spring. Those which descend from the hunter are preferable to those of a less noble parentage, having a cleaner and lighter action; they will stand fast work better, and their wind is more lasting.

The Welsh pony is a beautiful little animal, standing about thirteen hands high. He has a neat, clean head, good shoulders, a capital back, and strong sinewy legs; his feet are remarkably sound and good, and stand the hard turnpike roads much better than most larger and heavier horses · he is hardy, will subsist almost on any fare, and is not easily tired out.

The Exmoor pony is ugly and diminutive in size, but he is hardy, active, and will stand a great amount of rough work. Youatt speaks of one ridden by a sportsman, who rode him at a gate eight inches higher than his back, which he cleared, the owner riding fourteen stone. He travelled on him from Bristol to South Molton, a distance of eighty-six miles, " beating the coach which runs the same road."

In the hilly parts of Devonshire wheeled carriages are less in use than in the southern counties of England, and the Exmoor ponies are much used by the small farmers for carrying all kinds of produce and manure. The former are carried in *crooks* formed of willow poles bent as ox-bows, and with one end much longer than the other. These are joined in pairs by cross-bars 18 inches or 2 feet long, and each horse has two pairs of them slung together, so that the shorter ends lie against the pack-saddle, and the longer stand 4 or 5 feet from each other, and rise 15 or 18 inches above the horse's back; within and between these *crooks* the load of corn, hay, straw, &c., is placed. "Manure is carried in *pots*, or strong coarse panniers, slung together in the same way, and the dung ridged up over the saddle. At the bottom of the *pot* is a falling door; and at the end of the journey the trap is unlatched, and the load falls out."

The Dartmoor pony is larger and plainer even than the Exmoor, but he is quite as hardy, sure-footed, and useful, and will manage to scramble over the rough roads and mountainous wilds of the country, where a larger horse would break down. They run in droves almost in a state of nature, and it is very difficult to catch them when wanted. The late Captain Colgrave, the governor of the Dartmoor prison, wishing to purchase one that from its superior figure took his fancy employed several persons to assist in separating it from the drove. They managed to stow it up into a corner against an abrupt rock, and a man on horseback rode forward, certain of having secured him; but, lo! upon his riding up to him the animal, rendered desperate, gave a sudden spring, bounded over man and horse, and joined his companions of the herd.

* Youatt, p. 59.

The Highland pony is smaller and worse made than the Galloway. He has a large head, a long back, is low in the forehead, short in the legs, with upright pasterns. His pace is slow, and not very agreeable to those accustomed to ride a better formed animal, his best pace being a canter. These animals are hardy from running out summer and winter, and they will scrape the snow from the heather with their feet to supply themselves with food. Accustomed to the bogs of the country, they will never trust one until they have first tried it with their noses, and then by patting it with their fore feet to ascertain whether it is sound enough to bear them. They are said to do the same before crossing a piece of ice; and in either case determine very promptly whether it is safe to proceed.

The Shetland pony, or *sheltie*, as he is called in Scotland, is, as his name denotes, a native of the most northern of the Scottish isles. This accounts for his diminutive size, which ranges from seven and a half to nine and a half hands in height. The shelties are, however, remarkable for the perfect symmetry of their form, and their gentle disposition, although not at all deficient in strength or spirit. They have a small head, a short neck, but fine towards the throttle, low and thick shoulders, short back, expanded and powerful quarters, flat and fine legs, and handsome well-formed feet. Their most distinguishing features are their flowing and bushy manes and tails, differing in these from any other breed. They are amazingly strong for their size; and one of them only nine hands, or three feet high, has been known to carry a man of twelve stone forty miles in a day.

Youatt relates a story of a friend of his, who being presented with one of these little creatures, seven hands, or twenty-eight inches high, was at a loss how to convey him home, which was several miles distant. "'Can we not carry him in our chaise?' said our friend. The strange experiment was tried. The sheltie was placed in the bottom of the gig, and covered up as well as could be managed with the apron; a few bits of bread kept him quiet, and thus he was safely conveyed away, and exhibited the curious spectacle of a horse riding in a gig." *

The same writer remarks that it is difficult to imagine that the sheltie and the ponderous dray-horse could possibly have the same origin; and the same doubt will apply to all other breeds of ponies. We may, however, account for the difference as arising from accidental circumstances, such as hard fare, severity of climate, neglect in the early stages of life, &c. These causes operating in a series of years, and a succession of many generations, would naturally produce a deterioration in qualities, or diminution in size, as the case might be. And, besides, after the wonderful transformations we have witnessed in the breeds of all cattle, by a little extra care and attention, we may reasonably argue that a contrary course would, in process of time, have the opposite effect.

Parkinson relates that his father had a mare that had fourteen foals all by the same horse, not one of which, at three years old, was under seventeen hands. When in the fifteenth foal he sold her to a neighbouring farmer, reserving the foal, which was to be delivered to him in twelve months. Her new master half-starved her; and at the end of the time she was so altered as scarcely to be known for the same. The foal too was very small, and although put to the most luxurious keeping was not more than fifteen hands at three years old. This is a case directly in point. Supposing that the foal had remained with the new master of the dam, it is probable that he would not have reached more than thirteen, or at most fourteen, hands; and a continuance of the same

* Youatt, p. 60.

privation of food and neglect, would in all probability have caused the breed to dwindle down to that of a pony, especially if a severe climate were superadded to hard fare and hard work.

A considerable number of horses, both for the use of cavalry and for agricultural purposes, are annually purchased in England, and exported to France. The Emperor Napoleon has paid great attention to the breeding of horses of late years, and a stud has been established, with depôts in different parts of the country, where a selection of the best stallions and mares is kept for the purpose. The institution, however, has not been attended with success equal either to the expectations of the Emperor, or the expense attending it, and attempts have recently been made to remodel its arrangements, but as the greater part of its former organisation is still retained, there is not much hope of its prosperity in future. The expense of maintaining 1,320 stallions and 87 mares and fillies in 1860 amounted to £150,000; and in 1861, with only 983 stallions and no mares, the sum was increased to nearly £167,000 sterling, or nearly £170 each.

A considerable number of the best English thorough-bred horses have been purchased at very high prices for the United States, Canada, Australia, and other British colonies; and apprehensions are entertained that it will materially interfere with the production of good racers and hunters in England. There is, however, still a large sprinkling of first-rate horses, of both full and half-blood, in the country, to keep up the stock, and the stud-book may still be referred to in confirmation. On the other hand, it is becoming a universal conviction, that farm work under the improved system of cultivation can be better performed by horses with a portion of blood in their veins than by the heavy cart-horses formerly in fashion, when weight of carcase was the *ne plus ultra* of power and efficiency. Where heavy weights are to be moved, such as the old stage waggons and the brewers' drays in London, it is granted that equal weight and power, found in the height and bulk of the animal frame, are required; the work being slow, and the draught over the stones or roads exacting a steady, heavy bearing upon the collar rather than superior agility and activity of movement. But these latter are essentially the qualities that agricultural horses are now required to possess; and we believe that most farmers of the new school, whatever may be the nature of the soil they cultivate, have adopted the plan of employing a lighter kind of horse than formerly, both in the plough and the waggon. The load of the latter is seldom heavier than ten quarters of wheat, which does not much exceed two tons, to convey which to mill, or otherwise, say ten miles, is light work for four well-fed horses. At harvest work especially, when despatch is the order of the day, the lighter horses have the decided advantage. What these want in weight of carcase is made up in muscle and spirit, which enable them to perform the severest work with less fatigue than those would sustain that have nothing but their bulky weight to get them through it.*

Whatever differences there may be in the characters and qualifications of horses, there are general rules to be observed in purchasing them, which apply to all breeds. The

* "*Bred* horses," says Lawrence, "are applicable to a greater variety of useful purposes than any other, excelling in nearly all. They have greater strength in proportion, from the superior toughness of substance in their tendons, muscles, and ligaments, and the solidity of their bones. They are able to carry greater weight, and with superior speed; proof of the first instance was apparent in that not very merciful experimental match, in which Mr. Vernon's Amelia beat the miller's horse at his own play, loading his back with sacks of flour. I remember to have seen Bullock, the brewer, riding twenty stone, cantering over the London pavement upon a little bred horse not above fourteen hands high."—*The Horse*, p. 209.

following directions are laid down by Culley, which, if attended to, will be found strictly correct. In regard to form, the head should be small and in proportion to the size of the animal; the nostrils expanded, the muzzle clean and fine, the eyes prominent and cheerful, the ears small, rather inclining forward than otherwise, and placed at a small distance from each other; the neck rising with an easy curve from the shoulders, and joining the head gracefully; the shoulders thrown back, and losing themselves insensibly upwards in the neck; the arm muscular, flat, and tapering from the shoulder; the knee full and sinewy, the leg or cannon rather solid than large, and flat or lathy rather than round; the pasterns long, and rather turning outwards; the hoof circular, and wide at the heel; the chest deep and full, the body round, the back deviating slightly from the straight line from the setting of the neck to the rump; the fillets broad and straight, the hips moderately wide apart, the quarters long, the tail set on in a straight line with the rump, the thighs strong and muscular, the legs clean, and the bones fine, flat, and lathy. When at rest he should stand in an easy, graceful, unconstrained posture, and perfectly upright on his legs.

As to the soundness, "wind and limb," as it is termed, of a horse, or freedom from the various ills that horse-flesh is heir to, although many of them, such as spavins, splints, thorough-pins, windgalls, blindness, lameness, broken-wind, glanders, &c. &c., may be easily detected by even a moderate judge, yet we would advise every one before concluding a purchase both to demand a written warranty and an examination by a veterinary surgeon of reputation, and who would reject a bribe.* The expense is usually half a guinea divided between the parties, or as may be agreed on.

With respect to the disposition of a horse, the following indications may generally be relied on:—A broad forehead and wide-set ears denote a sluggish, stubborn, and obstinate temper; a narrow forehead and wide-set ears are decided signs of viciousness. Close-set ears, rather inclining backward, indicate a timid and fearful, rather than a vicious, disposition, but are equally dangerous, as betraying a liability to take fright and bolt. Such horses generally look behind them, and are ready to start on the least appearance of danger. The reverse of these characteristics are a well-proportioned forehead, well-planted and rather forward-pointing ears; a bold but pleasant eye and countenance generally. Such a horse must be badly used indeed to prove vicious.

* A nobleman (by courtesy) once called on a celebrated veterinary surgeon in Dublin, and stated that he had sold a horse for 120 guineas, and that the purchaser claimed an examination by him. "Now," added the party, "I think I can trust you" (laying a £10 note carelessly on the desk) "to give a fair and satisfactory report of the horse. He is a fine creature, and I have no doubt you will find him worth the money."—"Very well, my Lord," replied Mr. W——, "you may rely on it, I will do you justice in the affair." The horse and the purchaser soon entered the yard, and the surgeon first tried his paces, and then examined his feet and legs. Having finished his inspection, "Well, my Lord," he said, "I find this horse *incurably lame all round*, and if you want to know his value I should say £5 would be the outside. With respect, however, to the £10 you were so liberal as to give me, as I have never yet taken a bribe in such cases, you shall have the satisfaction of knowing that it is handed over to a benevolent institution."

SECTION X.

THE OX.

Ox is a generic term for all animals of the Bovine species. It belongs to the class *mammalia*, or animals having mammæ or teats; the order *ruminatia*, or chewing their food a second time; the tribe *Bovidæ*, the ox kind; the genus *Bos*, the ox, the horns occupying the crest, projecting at first sideways, and being porous or cellular within; and the sub-genus *Bos taurus*, or the domestic ox.

The ox derives its importance amongst the domestic animals of the United Kingdom from its services as a beast of draught, and as supplying a large portion of food to the inhabitants. In the former capacity its use is now confined to a comparatively very small section of the country, the horse being now all but exclusively used in agricultural labour; but for food upwards of 2,000,000 oxen are slaughtered annually in the kingdom, averaging about sixty imperial stones each, of which 277,000 are appropriated to the metropolis alone. Besides these, there are kept 3,000,000 cows, producing nearly 700,000,000 gallons of milk, and a proportional quantity of butter and cheese, while the refuse produce of the dairy forms the partial food of a large number of pigs. To these important services must be added the value of the skin, in supplying us with leather and hair for various purposes; the tallow, for affording us light; and the bones, horns, and hoofs, partly for manufacturing innumerable articles for ornament or use, and partly for application as a most valuable manure. When, therefore, we combine all these services rendered in the life and death of the ox, we shall have no hesitation in forming a just estimation of him in the domestic economy of the country.

The ox is distinguished from animals of the horse kind by the absence of cutting teeth in the upper jaw; in the lower jaw they have eight *incisors*, or cutting teeth, and six *molars*, or grinding-teeth, in both lower and upper jaws on each side. In all, therefore, they have twenty in the lower, and twelve in the upper jaw, or thirty-two in both.

The period of gestation of the cow differs slightly with the sex of the calf. In case of a bull calf, Lawrence found it to be 287 days, or forty-one weeks, with a variation of a few days either way. With a cow calf her time is a week less, with a similar variation. The term of life of a bull or cow he reckons to be about twenty years. The cow breeds, and yields milk, almost to the end of life, but the bull loses his vigour and usefulness much sooner. The age of the ox may be ascertained by the teeth up to a certain period. Thus, the first front teeth in the lower jaw at two years old are replaced by others less white; each of the three succeeding years two other calves' teeth are also replaced, and at five years old the incisory or cutting teeth are all replaced with others of greater length and substance, and the animal is full-mouthed. At six, the mark on the teeth is completed, after which the age, like that of a horse after seven, must be guessed at, so far as the teeth are a guide. The horns, however, supply their place. At three years old they shoot their first horns; at four a button, or bud, rises in place of the horn; at five this is pushed forward by another, which is separated from it by a ring, and each succeeding year of the animal's life a fresh ring is formed; and thus, allowing three years for the first ring, the age of an ox may thenceforth be ascertained by the number of these rings to the end of the life of the animal.

The history of the ox, like that of all other domestic animals, must be referred back to the Flood, and its native country, to the plains of Ararat, where the ark of Noah rested. Cattle are mentioned as being a possession of man* before that catastrophe which reduced the number of living animals to the few that vessel would contain. Afterwards, animal food, by express Divine permission, became a regular part of human sustenance, and ever since, in the old continents at least, the ox has been found either in the wild or the domesticated state, or in both conditions. Both sheep and oxen are mentioned continually, from the earliest periods of sacred as well as of profane history, and the latter establishes the fact of not only the domestication, but of the veneration as an object of idolatrous worship, of the ox amongst the inhabitants both of Egypt and India. The legends of the latter state that it was the first animal created by the three gods who were commissioned by the supreme Lord to furnish the earth with animated beings. The cow is represented in the traditions of the Celtic nations as a species of divinity.†

From the traditions of both England and every part of the continent of Europe, there is reason to think that formerly the ox was much larger than those of the present day; and this is confirmed by the skulls of these animals which have been dug up and preserved. The skull of the dun cow, encountered by Guy, Earl of Warwick, and which is preserved in Warwick Castle, is a proof that, at least, a wild breed of oxen of a large size existed in England at that period. That England was noted for the great numbers of its cattle at the time of the Roman invasion is confirmed by the Commentaries of Cæsar; and that the inhabitants lived chiefly on meat and milk. There were also wild as well as domesticated oxen, and the woods with which this country then abounded served as retreats for the former. During the frequent wars that raged, the cattle were turned or broke loose, and betook themselves to these forests, where they became wild and ferocious. Even in the neighbourhood of London herds of wild cattle existed, and were dangerous to the inhabitants. With the forests, these have long since passed away, and the only types of them now existing in Britain are to be seen in the park of the Earl of Tankerville's estate of Chillingham Castle, in Northumberland, and in Chatelherault Park, the seat of the Duke of Hamilton, in Lanarkshire. The following is the description given of these cattle by Culley:—

"The wild breed, from being untameable, can only be kept within walls or good fences, consequently few of them are now to be met with, except in the parks of some gentlemen, who keep them for ornament, and as a curiosity. Those I have seen are at Chillingham Castle, in Northumberland, the seat of the Earl of Tankerville.

"Their colour is invariably of a creamy white, with black muzzle; the whole of the inside of the ear, and about one-third of the outside, from the tips downward, red; horns white, with black tips, very fine, and bent upwards; some of the bulls have a thin upright mane, about an inch and a half, or two inches long. The weight of the oxen is from 35 to 45 stones, and of the cows from 25 to 35 stones, the four quarters (14 lbs. to the stone). The beef is finely marbled, and of excellent flavour.

"From the nature of their pasture, and the frequent agitation they are put into by the curiosity of strangers, it is not to be expected that they should get very fat; yet the six-years-old oxen are generally very good beef, from whence it may fairly be supposed that in proper situations they would feed well.

"At the first appearance of any person they set off in full gallop; and at the distance

* Gen. iv. 20. † Youatt.

of about 200 yards make a wheel round and come boldly up again, tossing their heads in a menacing manner; on a sudden they make a full stop at the distance of forty or fifty yards, looking wild at the object of their surprise; but upon the least motion being made, they all turn round again, and fly off with equal speed, but not to the same distance: forming a shorter circle, and again returning with a bolder and more threatening aspect than before, they approach much nearer, probably within thirty yards, when they again make another stand, and again fly off. This they do several times, shortening their distance and advancing nearer and nearer, till they come within such a short distance that most people think it prudent to leave them, not choosing to provoke them further.

"The mode of killing them was perhaps the only modern remains of the grandeur of ancient hunting. On notice being given that a wild bull would be killed on a certain day, the inhabitants of the neighbourhood came mounted, and armed with guns, &c., sometimes to the number of 100 horse, and 400 or 500 foot, who stood upon walls or got into trees, while the horsemen rode off the bull from the rest of the herd, until he stood at bay, when a marksman dismounted and shot. At some of these huntings twenty or thirty shots have been fired before he was subdued. On such occasions the bleeding victim grew desperately furious from the smarting of his wounds, and the shouts of savage joy that were echoing from every side; but from the number of accidents that happened, this dangerous mode has been but little practised of late years, the park-keeper alone killing them with a rifle gun at one shot.

"When the cows calve they hide their calves for a week or ten days in some sequestered situation, and go and suckle them two or three times a day. If any person come near the calves, they clap their heads close to the ground, and lie like a hare in form, to hide themselves; this is a proof of their native wildness, and is corroborated by the following circumstance that happened to the writer of this narrative, who found a hidden calf, two days old, very lean and very weak; on stroking its head it got up, pawed two or three times like an old bull, bellowed very loud, stepped back a few steps, and bolted at his legs with all its force. It then began to paw again, bellowed, stepped back, and bolted as before; but knowing its intention, and stepping aside, it missed him, fell, and was so weak that it could not rise, though it made several efforts; but it had done enough; the whole herd were alarmed, and coming to its rescue, obliged him to retire, for the dams will allow no person to touch their calves without attacking them with impetuous fury."

Such are the animals from which it is assumed the breeds of cattle of the United Kingdom, or at least of England, were originally derived. It would be difficult to trace them back through all the vicissitudes to which the landed property, and consequently its produce, have passed since the time of the Roman conquest. The assumption, therefore, must be taken for granted; and, at any rate, these wild cattle form a curious contrast with the different races which now compose the herds of Great Britain.

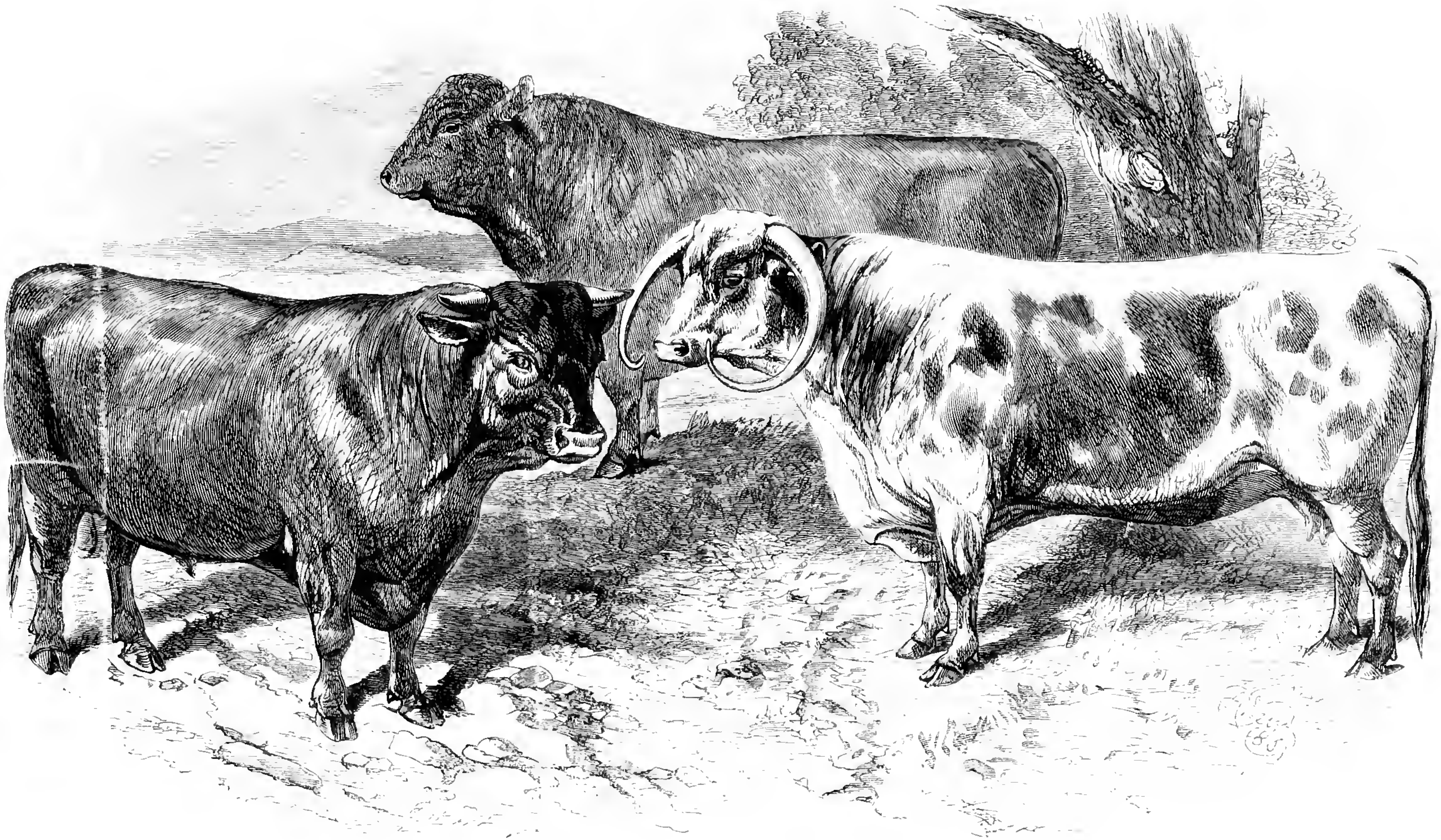
The various breeds of cattle, which in fact are almost as numerous, nominally, as the counties, are reduced by modern writers into three generic classes, namely, the *Long Horns,* originally from Lancashire; the *Short Horns,* which are claimed by the East Riding of Yorkshire, and Durham; and the *Middle Horns,* a distinct race, valuable and handsome, which are spread over the counties of Devon, Hereford, Gloucester, Sussex, and in Wales and Scotland. In these two latter countries the types differ from the rest chiefly in size, which is probably owing to the scanty pasture and more severe climate to which they are compelled to submit. Besides these three breeds, there is a race of *hornless* cattle found in Galloway, in Scotland, and in Norfolk and Suffolk, besides a polled variety of the *Devons*, called *Nats*, which will be noticed in their place.

The question which of the above is the original breed of British cattle is narrowed to the claims of the Long and the Middle Horns, the Short Horns being now universally admitted to have been imported at no very distant period from the Continent. Youatt inclines to yielding the palm to the *Middle Horns*, from the belief that the *Long Horns* were of Irish extraction. There is no doubt that in the midst of the distractions, caused by invasion on the one hand, and civil war on the other, the most secure places to which the landed proprietors could drive their cattle, which formed their most valuable moveable property, would be the strongholds of North Devon, East Sussex, and Cornwall, the Welsh mountains, and the Highlands of Scotland; and it is in these secluded districts that we find the *Middle Horned* race of cattle in the greatest purity and perfection. It is worthy, too, of remark, that the cattle of these different parts of the kingdom, whatever varieties may appear among them, agree in all essential characteristics, such as in yielding a small quantity only of milk, but of the richest quality; in being well fitted for agricultural labour; and in their uniform aptness to fatten; and whatever differences may exist amongst them are to be ascribed to the character of the soil, climate, and other accidental circumstance to which they have been subjected. It is said that, setting aside the difference of colour, which of itself may have been accidental, a comparison of the Devon cattle with the wild breed of Chatelherault Park and Chillingham Castle, will show the extreme probability that they descend from the original stock, differing as they do, in all respects, from the cattle of the neighbouring counties.

SECTION XI.

THE MIDDLE HORNS.—1. THE DEVONS.

These are reckoned a mountain breed, and are certainly the aristocracy of the Bovine species. They are still found in their native purity on the banks of the Taw, westward, skirting along the Bristol Channel, extending inland by Barnstaple, South Molton, and Chumleigh, as far as Tiverton, and thence to Wellington. Beyond these places, the breed becomes mixed with local varieties, as eastward with the Somersets and Welsh; south with Somersets; and Welsh with the Cornish. The Devonshire farmers are of opinion that the only district in which the pure Devons are to be found is that lying between Portlock and Bideford, and a little north and south of that line. Here the breed has certainly remained the same from time immemorial, only improved as the native breeders began to discover their value, which does not appear to have been the



DEVON. SUFFOLK. LANCASHIRE.

case till the Board of Agriculture pointed it out to them. Youatt considers that Devonshire is more indebted to the nature of its soil and climate for its fine race of cattle than to any efforts of the farmers to improve it. What change has taken place in this respect has been owing to the enterprise and energy of persons unconnected with the county, who, by both precept and example, have stimulated the native breeders to the task. The result has been that the Devon cattle have arrived at such a pitch of perfection that no crosses with any other breed could be attempted without deterioration. The following description of them was written by Youatt, and is as perfectly applicable to them now as when it was penned :—

"The more perfect specimens of the North Devon breed are thus distinguished. The horns of the bull ought to be neither too low nor too high, tapering at the points, not too thick at the root, and of a yellow or waxy colour. The eye should be clear, bright, and prominent, showing much of the white; and it ought to have around it a circle of variable colour, but usually a dark orange. The forehead should be flat, indented, and small; for by the smallness of the forehead the purity of the breed is very much estimated. The cheek should be small, and the muzzle fine; the nose should be of a clear yellow. A black muzzle is disliked, and even a mottled one is objected to by some who pretend to be judges of the true Devon. The nostril should be high and open; the hair curled about the head, and giving at first appearance an idea of coarseness, which soon wears off. The neck should be thick, and that sometimes almost to a fault.

"Excepting in the head and neck, the form of the bull does not materially differ from that of the ox, but he is considerably smaller. There are some exceptions, however, to this rule. The head of the ox is small, very singularly so, relatively to the bulk of the animal, yet it has a striking breadth of forehead. It is clean, and free from flesh about the jaws. The eye is very prominent, and the animal has a pleasing vivacity of countenance plainly distinguishing it from the heavy aspect of many other breeds. Its neck is long and thin, admirably adapting it for the collar, and even for the more common and ruder yoke. The want of the beautifully arched form of the neck, which is seen in the horse, has been considered as a defect in most breeds of cattle. It is accounted one of the characters of good cattle that the line of the neck, from the horn to the withers, should scarcely deviate from that of the back. In the Devonshire ox, however, there is a peculiar rising of the forehand, reminding us not a little of the blood-horse, and essentially connected with the free and quick action by which this breed has ever been distinguished. It has little or no dewlap depending from its throat. The horns are longer than those of the bull, smaller, and fine even to the base, and of a lighter colour, and sometimes tipped with yellow. The animal is light in the withers; the shoulders a little oblique; the breast deep, and the bosom open and wide, particularly as contrasted with the fineness of the withers. The fore legs are wide apart, looking like pillars that have to support a great weight. The point of the shoulder is rarely, or never seen. There is no projection of bone, as in the horse, but there is a kind of level line running on to the neck. These are characteristic and important points. Angular, bony projections are never seen in a beast that carries much flesh and fat; the fineness of the withers, the slanting direction of the shoulders, and the broad and open breast imply both strength and speed, and aptitude to fatten. A narrow-chested animal can never be useful either for working or grazing.

"With all the lightness of the Devonshire ox, there is a point about him disliked in the blood or riding-horse, and not always approved in the horse of light draught,—the legs are far under the chest, or rather the chest projects far and wide before the legs. We see the advantage of this in the beast of slow draught, who rarely breaks into a trot, except when he is goaded on in *catching times*, and the division of whose foot secures him from stumbling. The lightness of the other parts of his form, however, counterbalances the appearance of heaviness here.

"The legs are straight, at least in the best breeds. If they are *in-kneed*, or crooked in the fore legs, it argues a deficiency in blood, and comparative incapacity for work, and not only for work, but for grazing too, for they will be hollow behind the withers—a point for which nothing can compensate, because it takes away so much from the place where good flesh and fat should be thickly laid on, and diminishes the capacity of the chest, and the power of creating arterial and nutritious blood.

"The fore arm is particularly large and powerful. It swells out suddenly above the knee, but is soon lost in the substance of the shoulder. Below the knee the bone is small to a very extraordinary degree, indicating a seeming want of strength; but this impression immediately ceases, for the smallness is only in front—it is only in the bone—the leg is deep, and the sinews are far removed from the bone. It is the leg of the blood-horse, promising both strength and speed. It may, perhaps, be objected that the leg is a little too long. It would be so in an animal that is destined only to graze; but this is a working animal, and some length of leg is necessary to get him pleasantly and actively over the ground.

"There is a very trifling fall behind the withers, but no *hollowness*; and the line of the back is straight from them to the sitting on of the tail. If there is any seeming fault in the beast, it is that the sides are a little too flat. It will appear, however, that this does not interfere with his feeding, while a deep, although somewhat flat, chest, is adapted for speed.

"Not only is the breast broad and the chest deep, but the two last ribs are particularly bold and prominent, leaving room for the stomachs and other parts concerned in digestion to be fully developed. The hips, or huckles, are high, and on a level with the back, whether the beast is fat or lean. The hind quarters, or the space from the huckle to the point of the rump, are particularly long and well filled up,—a point likewise of very considerable importance both for grazing and working. It leaves room for flesh in the most valuable part; and, like the extensive and swelling quarters of the blood-horse, indicate much power behind, equally connected with strength and speed. This is an improvement quite of modern date. The fulness here, and the swelling out of the thigh below, are of much more consequence than the prominence of fat, which is so much admired on the rump of many prize cattle.

"The sitting on of the tail is high; it is on a level with the back, rarely much elevated, and never depressed. This is another great point in the blood-horse, as connected with the perfection of the hind quarters. The tail itself is long, small, and taper, with a round bunch of hair at the bottom.

"The skin of the Devon, notwithstanding his curly hair, is exceedingly mellow and elastic. Graziers know that there is not a more important point than this. Where the skin can be easily raised from the hips, it shows that there is room to set on fat below. The skin is rather thin than thick. Its appearance of thickness arises from the curly hair with which it is covered, and curly in proportion to the health and condition of the animal. Good judges of these cattle speak of these curls as running like ripples of wind on a pond of water. Some of these cattle have the hair smooth; but then it should be fine and glossy. Those with curled hair are somewhat more hardy, and fatten more kindly. The favourite colour is a blood red: this is supposed to indicate purity of breed; but there are many good cattle approaching almost to a chestnut hue, or even a bay-brown. If the eye is clear and good, and the skin mellow, the paler colours will bear hard work, and fatten as well as the others. But a beast with a pale skin, and hard under the hand, and the eye dark and dead, will be a sluggish worker and an unprofitable feeder. Those, however, that are of a yellow colour, are said to be subject to *steat* or diarrhœa. Some breeders object to the slightest intermixture of white,—not even a star upon the forehead is allowed; yet a few good oxen have large distant patches of white; but if the colours run into each other the beasts are condemned, as of a mongrel and valueless breed."

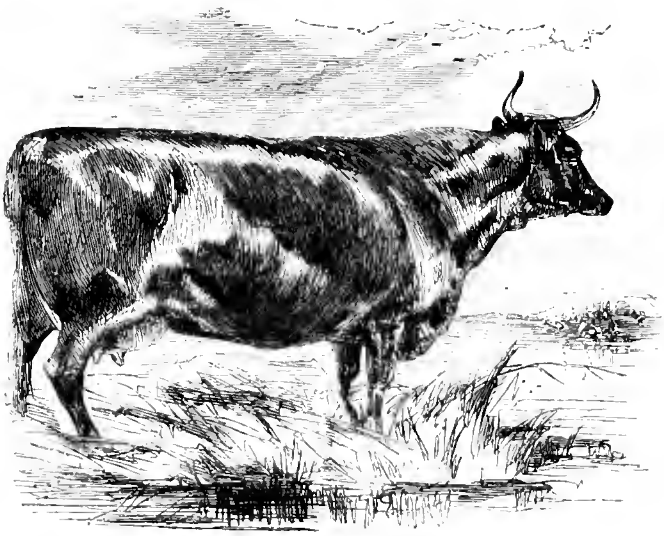
The above description was drawn out nearly thirty years ago, and is a perfect rule to judge of these cattle, although by the skilful attention paid by more modern breeders to pedigree and selection, in order to remedy those defects which, now that grazing is the principal object to which the Devon cattle are appropriated, required removal, their symmetry is more in accordance with present ideas or taste. The Devons were introduced into Norfolk by the late Earl of Leicester (then T. W. Coke, Esq.) about the beginning of the present century; and it is no small testimony to the excellence and value of the breed, that it has been retained at Holkham ever since in all its purity, and is also a general favourite with most of the wealthy farmers on that estate, as the appearance of so many of them at the Smithfield and other cattle shows evinces. The improvements effected consist in the reduced size of the bones, greater squareness of the form, and roundness of the ribs, and the extraordinary precociousness, by virtue of which they now attain as great a ripeness at two or two and a half, as they formerly did at four or five, years of age, and nearly as great a weight also. The flesh has a remarkably delicate flavour; and they are much esteemed by the London as well as country butchers, and will always command the highest price in the market of the metropolis.

The Devonshire cow is small in proportion to the bull or the ox. She is distinguished by a clear, full eye, with a gold coloured ring round it; the inside of the ear being the same colour. She has a cheerful countenance, an orange or yellow muzzle, the rest of the face being red: the jaws are fine, and the throat has no dewlap. The points of the back and hind quarters are round and handsome, in which respect they differ from the angular appearance of those of cattle that are noted for their good milking qualities. In fact, the Devon cows are not good milkers in respect to quantity; but what they do yield is very rich, and produces the first-rate cream and butter, the latter always commanding the highest price in the London market. Lawrence questions this, and says:—"As milkers they are so far inferior to both the Long and Short Horns, namely, both in quantity and *quality* of milk, that they are certainly no object for the regular dairy, however pleasing and convenient they may be in the private family way." This is true only so far as the quantity of milk yielded by them is concerned;* that

* Many years since, a tenant of Mr. Coke (the late Mr. Purday, then of Egmere) was persuaded by his landlord to set a dairy of Devon cows. He was a first-rate farmer and grazier, and the writer recollects his selling a two year old Devon bull for 500 guineas, which of itself proves the excellence and purity of the stock. It was Mr. Coke's practice when he

the quality is inferior to that of other cattle is disproved by the rich cream and butter for which the county of Devon has always been celebrated, and which is doubtless the produce of the native breed of cattle.

It is, however, as working and grazing cattle that the Devons are most distinguished. In regard to the first qualification, they stand without rivals in the plough where the land is not too strong and heavy. Their quickness of action, docility, good temper, and perseverance, are nearly equal to those of the horse. Youatt says that four of them in a two-furrow plough will turn over two acres in a day; and that four of them in a waggon will do as much work either in the field or on the road as three horses. It is true that on a very stiff clay they fail; but it is rather in strength than in "bottom,"



THE DEVON COW.

for they will attempt to accomplish it to the last. Lawrence goes so far as to assert that by a little attention to the breed they might be adapted to the saddle † as well as the yoke; and he quotes an instance of one, which, for a wager, was ridden thirty miles in two hours.

Four oxen, or six growing steers, constitute the team for a plough, and they are attended by a man and a boy, the former to hold the plough, the latter to drive. Youatt gives a pleasing description of the rural habits of these husbandmen. "The boy chants that which can scarcely be regarded as any distinct tune, but which is a very pleasing succession of sounds resembling the counter-tenor in the service of the cathedral. He

had friends at the Hall, to take them to see the farms of his tenants; and, amongst others, Mr. Purday's Devon Dairy was a favourite hobby for him. On one occasion he brought a noble lord to see these Devon cattle; and his lordship, after admiring them very much, asked the farmer how it was that he spoiled his dairy by keeping amongst the others three ugly Suffolk polled cows, "which were quite a disgrace to the rest." "Well, my lord," replied the honest farmer, "I'm proud of my Devons, to be sure, and Mr. Coke is as proud of them as I am; but, after all, my lord, you know, *we must have a little milk and butter for the family.*"

† About the close of the last century, when taxes were high and horse keep dear, an eccentric gentleman in the west, a "radical reformer," in order to avoid the horse tax, had a Devonshire ox trained to the saddle, and rode on him about the country in the neighbourhood of Bath and Bristol, to the no small amusement of the natives. But he had it all to himself, as no one followed his patriotic example.

sings away with unwearied lungs as he trudges along, almost from morning till night, while every now and then the ploughman, as he directs the movement of the team, puts in his lower notes, but in perfect concord. When the traveller stops in one of the Devonshire valleys, and listens to this simple music from the drivers of the ploughs on the slopes of the hill on either side, he experiences a pleasure which this operation of husbandry could scarcely be supposed capable of affording. This chanting is said to animate the oxen somewhat in the same way as the musical bells that are prevalent in the same county. Certainly the oxen move along with an agility that would scarcely be expected from cattle; and the team may be watched a long while without one harsh word being heard, or the goad or whip applied. The opponents of ox husbandry should visit the valleys of North or South Devon to see what the animal is capable of performing, and how he performs it."*

If any breed of cattle can be profitably employed in husbandry it is certainly the Devons; but the question is commercially settled against the practice by the new or modern system of grazing, by which the ox can be got ready for the butcher, and turned to profit by the time he arrives at the age when it is requisite to break him in to the yoke, and *before* he has attained his full efficiency of power or skill. Even when broke he must be worked *lightly* on the hills for two years, until he is four years old, and then he may be put to hard work until six. At that age, if it is intended to make the *best beef* of him, he should cease working and be put to high feed, in order to fit him for the butcher, which takes another six or twelve months, according to his previous condition. The graziers, however, prefer having him at five years old, and will give nearly, or quite as much money for him then as at six; so that the modern breeder has turned his cattle into cash *twice over* in the time, during which he who works his, has only obtained one or two years' full labour from them. As to the extra capital required for horses, that is compensated for by the quicker return and the profit on the fattened cattle; and the greater number of them employed than are necessary of horses, may fairly be set against the more expensive keeping of the latter.

The Devons are good feeders, and display great aptitude to fatten. Probably they lay on more flesh and fat on the best parts with a given quantity of food than any other breed; and although they do not attain the size or weight of the Long or Short Horns, the quality of the meat makes amends for the deficiency in quantity or weight. The butchers will at any time give a much higher price for a Devon ox or steer than for either of the two just named. The improved Devons, however, attain a much greater weight than those of a former period.

In North Devon the calves are dropped at and soon after Michaelmas, which time is preferred to the spring, on account of their having thus the advantage of half a year's age when first put to spring work. The calf is allowed to suck three times a day for a week, and is then accustomed to the finger, warm new milk being given to it for three weeks longer. For two months afterwards warm scalded milk is given liberally, mixed with a little finely-powdered linseed-cake. Its morning and evening meals are then lessened, and at four months it is wholly weaned.

In South Devon, on the borders of Cornwall, a larger breed is reared to supply the navy with beef. It is found in perfection in the tract of country from Tavistock to Newton Abbott, where the oxen frequently reach a weight of more than 100 stone the

* Youatt on Cattle, p. 18.

four quarters (14 lbs. to the stone). They resemble the Herefords so nearly as scarcely to be distinguished from them in some cases. In East Devon but little attention is paid to the purity of the breed. The calves are reared for supplying other districts with young stock. The calf is allowed to run with the cow ten or twelve months, and if it has fattened it is then slaughtered. If it has held itself rather in a growing than a fattening condition, it is kept longer on the rough pastures, and afterwards sold at the fairs, or to jobbers. The best types are, therefore, killed at an early age, only the inferior being retained for stock. It is at the fairs and markets of North and South Devon that the superior specimens of this excellent breed of cattle are to be obtained.

SECTION XII.

THE MIDDLE HORNS.—2. THE CORNWALL BREED.

There is a native breed of cattle in Cornwall, found on the moors in the western parts. They are described by Youatt as a small, black, coarse-boned race, with rather short horns, large offals, and rarely weighing more than three or four hundredweight. (24 to 32 stone of 14 lbs.). They resemble the native breeds of Wales and Scotland, are very hardy, and suit the changeable climate of Cornwall. They are good milkers, and keep themselves on the moors at small expense, requiring in winter only the native heather, furze, and straw to sustain them; but they fatten quickly when put into good pasture. This breed is sometimes crossed with the North Devon, which certainly improves it in size; but the produce does not come up to the Devon in excellence in any respect, so that it is difficult to discover the advantage of the cross, while the native breed is so well adapted to the country. In most parts of Cornwall, except the western, the North Devon cattle prevail, and are quite equal to any their native county produces. They are, in fact, purchased of the best Devonshire breeders, the finest types, both male and female, being selected. Numbers of one or two year old steers are also purchased; and these are worked till they are eight or ten years old, when they are either sold to the grazier or fattened at home. Both the Alderney and the Short Horn (Durham) have been introduced and crossed with the native cattle, to raise a stock for the dairy as well as the butcher. The North Devons, however, are the favourites with the Cornish farmers, who cannot do better, we think, than to adhere to them. It is proper to state that the use of oxen in husbandry has long been declining in Cornwall: and the horse is, in almost all cases, the only animal employed at the plough.

SECTION XIII.

THE MIDDLE HORNS.—3. THE SOMERSETSHIRE BREED.

The indigenous breed of cattle of this district is described as having a crescent-formed, turned-up horn, between that of the Sussex and the original Short Horn; useful and heavy, high on its legs, particularly behind. It was used for the supply of the shipping, and sent to Salisbury market, and thence forwarded to Portsmouth. The cows were good milkers, and fattened kindly.

In that part of the county bordering on Devonshire the Devon cattle prevail as far as Wincanton, and from thence to Bristol and Bath. They are of a larger size than in their native county on account of the richer pasturage and soil. They are better grazers than milkers, and are rather preferred on the score of their ready fattening, than their adaptation to the dairy. In North Somerset we lose the Devons, and the Short Horns have been adopted, with some Long Horns from North Wilts. These two breeds are preferred on account of their milking qualities. If a heifer at three years old displays a disposition to fatten, she is at once turned out of the dairy, it being considered incompatible with the power of yielding a full pail of milk. Middle Somerset is a grazing district from the Mendip Hills on the north to Bridgewater on the west, and Chard on the south. The Devons, for summer fattening, are bought in February, either in North Devon or the lower part of Somerset. They are fed on inferior hay until the grass is ready, when they are turned out, being allowed from an acre to an acre and half to an ox, accompanied with one sheep. They are fat by Michaelmas, and pay the grazier from 3*s.* 6*d.* to 4*s.* per week for their keep. They are sold for the Salisbury or London markets. Some are kept over, and given another summer's grass.

The number of calves reared in the district is very great. They are dropped from February to Lady-day; and four hundred have been sold in Shepton Mallet market in one day. Since railways have offered such facilities for the transit of both live and dead meat, a large proportion of the calves are slaughtered by the butchers or farmers at home, and taken to the Bristol and Bath markets, and even to London, where they bring a better return. Those calves that are reared are fed chiefly on cheese-whey until May, when they are turned out to grass. In some parts they are taken from the cows at three days old, and suckled by hand. It requires three cows to fatten two calves up to from thirty-five to fifty pounds per quarter. Soon after Lady-day, when cheese-making begins, the milk is wanted for the cheese vat. Instead, then, of the milk, the dairy-maid warms the whey in a large copper, which forces a further portion of curd; and this, with a small quantity of milk and a little linseed-meal, completes the fattening of the calf. The reared calves are fed with the whey alone.

Large quantities of cheese are made in the parishes of Huntshill, South Brent, and East Brent. The land is rich, cool, and free from those odoriferous herbs which injure the flavour of cheese. The dairies consist chiefly of cows of a cross with the Durham Short Horn; and one of forty usually contains twenty-five red, ten spotted, and five with a white face. The Cheddar cheese is made in the above-named parishes and round Glastonbury. The dairymen keep their cows till they are ten or twelve years old, and then turn them off only because the *quality*, and not the quantity of milk is deteriorated. At this age they are only half the value of a Long Horned cow; but they have made more cheese, and taken less to keep them, than the Long Horns, which decides the question of profit in favour of the Somerset cow.

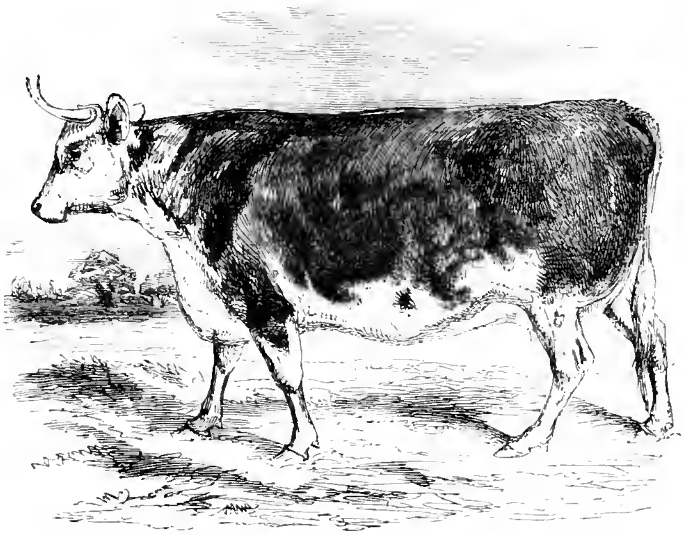
SECTION XIV.

THE MIDDLE HORNS.—4. THE HEREFORDSHIRE BREED.

Having described the Devon cattle in its various localities and types, we now come to another distinct type of the Middle Horned race. These are larger than the Devons; and some are of a darker red, while others are brown, yellow, or brindled. The distinguishing marks are their white faces, throats, and bellies. The old Herefords were brown or reddish-brown, without a spot of white about them; but the change in the colour has been attended with a decided improvement in the animal. The skin is much thicker than that of the Devon, and the beasts are more hardy. They are shorter in the leg as well as in the carcase; higher, broader, and heavier in the chine, rounder and wider across the hips, and better covered with fat; the thigh fuller and more muscular, and the shoulders larger and coarser. The following is Mr. Marshall's description of them:—"The countenance pleasant, cheerful, and open; the forehead broad; the eye full and lively; horns bright, taper, and spreading; chest deep; bosom broad and projecting forward; shoulder-bone thin, flat, no ways protuberant, but full and mellow in flesh; head small, chap lean; neck long and tapering; loin broad; hips standing wide, and level with the chin; quarters long and wide at the neck; rump even with the level of the back, and not drooping or standing high and sharp above the quarters; tail slender and neatly haired; barrel round and roomy; the carcase deep throughout and well spread; ribs broad, standing flat and close on the outer surface, forming a smooth even barrel, the hindmost large and full of length; round bone, small, snug, and not prominent; thigh clean, and regularly tapering; legs upright and short; bone below the knee and hock small; feet of middle size; flank large; flesh everywhere mellow, soft, and yielding pleasantly to the touch, especially on the chine, the shoulder, and the ribs; hide mellow, supple, of a middle thickness, and loose on the neck and huckle; coat neatly haired, bright, and silky; colour a middle red with a bold face characteristic of the true Herefordshire breed."

It is the universal opinion amongst the learned in cattle, that in the middle of the last century the Herefordshire graziers had large herds of the old Herefords as described above, as pure red as the Devons themselves. The present stock, therefore, as exhibited at the various cattle shows, and which are of various colours, must be the produce of crosses with Short Horns or other breeds, there being neither oneness nor uniformity of colour among them.

The Herefords fatten to a larger size than the Devons. The weight of the oxen sometimes reaches from 70 to 100 stone; and they gain this weight at a much earlier period of life than formerly. Their flesh is well marbled, and is little inferior to the Devon beef. They are not much used in husbandry work in their native county, the graziers preferring to have them ready for the butcher at three years old, to working them after that age. As milkers they are even behind the Devons, and a dairy of them is rarely seen. But they excel the Devons in fattening qualities; and will accumulate flesh where the latter would scarcely keep up their condition. Although they are rather coarse in the fore-quarter, and large in the bone, their best parts are finely grained, and they open so well, that the butchers readily purchase them in preference to other breeds.



THE HEREFORD COW

The Hereford cow is, in appearance, a very inferior animal to the Devon. She is a worse milker, and is smaller and cross-made, according to our notions of symmetry. But the Herefordshire breeders select their cows on account of that general form which experience teaches will render them likely to produce a good ox. They are light-fleshed when in common condition; and beyond that, while breeding, they are not suffered to proceed. But, when actually put up for fattening, they spread out and accumulate fat at a most extraordinary rate.* Very few oxen are fattened in their native county; those consumed there are chiefly heifers and old cows. The oxen are sold at five and six years old to the graziers of Buckinghamshire and other counties, from whence, when fat, they find their way to the London market.

The improved Herefords, of which the best types are to be seen at the Smithfield Club Cattle Show, are of various colours, although red is the prevailing hue. By dint of attending to the Bakewellian system, breeding from the best cattle, and adhering to pedigree, the same precocity observed in the Devons has been attained in the Herefords; and they are now got ready for the butcher at two and a half or three years old instead of five or six. Some beautiful specimens were exhibited at the show in

* Youatt, p. 33.

Baker Street last Christmas (1861); and a cow of this breed, *Lady Ash*, the property of Mr. R. Hill, of Golding Hill, Shrewsbury, won the gold medal and the prize of £25. This cow was five years and two months old, and had had two calves.

The Herefordshire breeders do not often cross their cattle with other breeds. Lawrence recommends them to avoid this, which, in his time, some were disposed to do, on account of a coarseness of bone generally displayed by the breed at that time. He reminds them of Marshall's description; and tells them, that possessing the finest and most valuable breed of cattle in the world, by judicious selection they would do well not to proceed any further, lest by crossing with inferior stock, *of which they could find no other*, they should recede from the high eminence they had attained. Should, however, a cross become necessary, he recommends a Norman or a Devon bull for that purpose.

The Herefords, like the Devons, are good feeders, fatten quickly, and attain a great weight. Lawrence mentions one which took the prize at the Smithfield Cattle Show in December, 1802, the carcase of which weighed 274 st. 6 lbs. and the offal 92 st. 5 lbs. (8 lbs. to the stone), in all 367 st. 3 lbs. This must, however, have been an exceptional specimen. The earliest breeders who attended to the improvement of this race were Skyrvine, Tully, and Yeomans. The stock of the first of these exhibited more white than those of any other breeder. They were generally large and heavy when fattened, and fetched great prices at Smithfield. The breed of the second were of a lighter red, and had speckled faces. A grey or roan variety is supposed to have originated in an intermixture of the red with those showing more white. Mr. Yeoman's stock did not differ materially from that of Tully. It is said that the late Mr. Westcar sold at Hereford fair at one time six oxen for 600 guineas; and that an old print of a Hereford ox has an account which states that it was sold for 160 guineas. We conclude that these were working cattle. Youatt relates an experiment made of three Short Horns and three Herefords, which in May, 1828, were weighed and sent to grass. They were taken in on the 2nd November, and put upon Swedish turnips and hay. They were all sold at Smithfield on the 30th of March following, when it was found that the Short Horns had increased 17 cwt. 2 qrs., and the Herefords 13 cwt. 2 qrs. 14 lbs.; but the former had consumed 12,775 lbs. of turnips, and 1,714 lbs. of hay more than the latter. The weight of the three Short Horns was 43 cwt. 2 qrs., and they sold for £97, or rather under 5*s.* 7*d.* the imperial stone. The Herefords weighed 37 cwt. 14 lbs., and sold for £96, or 6*s.* 5*d.* per stone; the Short Horns only paying £1 for the large extra quantity of food they had consumed.

In Gloucestershire the Hereford cattle prevail to a great extent for working and grazing. It had formerly a breed peculiar to itself, which appears to have been a cross between the Hereford and Welsh. Their colour was red or brown, horns middle length, white tipped with black, bone small, and carcase light. The cows had a large bag, and were excellent milkers. These were long ago crossed with Long Horns, which produced a larger breed, that fatted readily, and were not much inferior in milking qualities to the native race. These are found chiefly in the Cotswold Hills. Other breeds have been introduced of late years, as the Suffolk Duns, Devons, Durhams, North Wilts, &c. The soil in this hilly country is poor, and is chiefly fed with sheep, except in the unsound pastures, which can only be profitably occupied with lean stock; these are sold at the close of summer to graziers from more fertile districts. Some that are wintered are kept in the field, being fed with straw; and even the milch cows have nothing but straw allowed them in the early part of winter. The heifers calve in April or May, and are then added to the dairy. The steers are put to work at two years old.

In the Vale of Gloucester or Berkeley, which reaches from the Cotswolds to the Severn, the soil is excessively rich, and large dairies are kept. Most of the cows have traces of the old Gloucester breeds, but crossed with other breeds according to the fancy of the dairyman. The Alderney also has been introduced and crossed with the native. The produce has both increased the quantity and improved the quality of the milk. A cross of the Gloucester and Hereford also has proved successful, the cows yielding from four to six gallons of milk per day. It is in the Vale of Berkeley that the famous Gloucester cheese is made. The land is rich, and produces abundance of grass. The richest of the pastures are devoted to the milch cows, and they are frequently moved from pasture to pasture to stimulate their appetites. "It has been found by experience, that manuring the grass lands, while it increases the quantity of milk, deteriorates materially the quality of the cheese. A dairywoman remarked to Dr. Rudge that if her master continued to enrich his land with dung, she would give up making cheese." * This is the chief product of the vale, and its excellence is well known and appreciated. We shall have occasion to refer to this again when treating of dairy management. Very few cattle are fattened in this district; but in the neighbourhood of Gloucester a considerable number of Hereford oxen are grazed. They are purchased in the spring, pastured till winter, and then stall-fed. When fat they are sent by rail to the London market.

SECTION XV.

THE MIDDLE HORNS.—5. THE SUSSEX BREED.

This is so much like the Devon that it is considered to have had the same origin. It is supposed that a colony of the ancient Britons took refuge from the attacks of their invaders in the Weald of East Sussex, which at that early period was probably covered with forests. "There they found or took some of their native cattle, and, as in the north of Devon, the mountains of Wales, and the Highlands of Scotland, they have preserved them pure from all mixture as relics of happier times, and records of what Britons once possessed." The following is Mr. Ellman's (of Glynde) description of the Sussex ox:—"A small well-formed head; horns pushing forward a little, and then turning upwards, thin, tapering, and long; not so as to confound this breed with the Long Horns, and yet in some cases a little approaching to them. The eye is full, large, and wild in the ox, but with some degree of quietness in the cow; the throat clear, and the neck, compared with either the Long Horns or the Short Horns, long and thin, yet evidently coarser than that of the Devon. At the shoulder is the main point of difference,

* Youatt, p. 40.

and the principal defect in the Sussex cattle. There is more wideness and roundness on the withers; it is a straighter line from the summit of the withers towards the back; there is no projecting point of the shoulder when the animal is looked at from behind; but the whole of the fore quarter is thickly covered with flesh, giving too much weight to the coarser and less profitable parts. This is certainly a defect, but it is counterbalanced by many admirable points. If there is more weight in front, the fore legs are necessarily wider apart, straighter, and more perpendicular than in the Devon; they are placed more under the body rather than seeming to be attached to the sides. The fore arm is large and muscular; but the legs, although coarser than those of the Devon, are small and fine downwards, and particularly below the fetlock. The barrel is round and deep, the back straight, no rising spinal processes are to be seen, but rather a central depression; and the line of the back, if broken, is only done so by a lump of fat rising between the hips. The belly and flank are capacious; there is room before for the heart and lungs to prepare and circulate the blood, and there is room behind in the capacious belly for the full development of all the organs of digestion: yet the beast is well ribbed home; the space between the last rib and the hip-bone is often very small, and there is no hanging heaviness of the belly or flank. The loins of the Sussex ox are wide; the hip-bone does not rise high, nor is it rugged externally; but it is large and spread out, and the space between the hips is well filled up. The tail, which is fine and thin, is set on lower than in the Devon; yet the rump is nearly as straight, for the deficiency is supplied by a mass of flesh and fat swelling above. The hind quarters are cleanly made, and if the thighs appear to be straight without, there is plenty of fulness within. The colour is a deep chestnut red; some, however, prefer a blood bay: much deviation from these colours generally indicates some stain in the breed. The black, or black and white, which is sometimes met with, indicates a cross with the Welsh. The hide of the true Sussex is soft and mellow; a coarse, hard, thick hide is supposed to denote here, as in every other district, an ill-bred, or an unthrifty beast. The coat is short and sleek."*

Oxen are much employed in some parts of Sussex in agricultural labour, whilst in others horses are preferred. The former practice, however, is, we believe, less prevalent than it once was. It is in the Weald of Sussex that the use of oxen is most general, while in the South Downs horses are more prevalent. The true Sussex is a light breed, and is as active as the Devon in the plough. Some teams have travelled fifteen miles a day with a heavy load for many weeks together, without the slightest distress. A Sussex ox ran four miles against time over the Lewes race-course, and accomplished the distance in sixteen minutes. They are usually taken from work at six, and slaughtered at seven. Youatt questions the propriety of this plan of recruiting the team so frequently. Some of the farmers work them till twelve years old; and Lord Egremont had a pair of Sussex oxen in the eleventh year of their age, which for seven years had done as much ploughing and carting as any two horses in the county; and then, with half a summer's grass after having been taken from the collar, and having an autumn's *rouen,* they were, without other food, sent to Smithfield, and sold for 80 guineas.† The average weight of the Sussex oxen is 120 st., but they sometimes attain nearly double that weight.

The Sussex cow is very inferior in symmetry to the ox. Her milk, although rich, is small in quantity; and the dairies of the county are made up of all other breeds, and "no one in particular." A cross has been tried between the native cow and the Suffolk

* Youatt, pp. 40-42. † Ibid., p. 43.

bull, and the product retained the good qualities of both parents—the fattening tendency of one, with the milking quality of the other. The Sussex cow is of a restless and dissatisfied temper, and ever attempting to break pasture. She is chiefly kept for breeding, the dairy purpose being a secondary object. When dried she will fatten very quickly. Nearly all the calves are reared, the males for working or grazing, the females for breeding or fattening. In the latter case they are spayed. Thus "on a farm on which eight cows are kept, there will commonly be six calves, six yearlings, six two-year-olds, four three-year-olds beginning to work, four four-year-olds, four five-year-olds, and four six-year-olds."*

The calves are permitted to suck for ten or thirteen weeks, and are weaned by being shut up and having grass given them until they have forgotten the dam, when they are turned out. They are fed with good hay the first winter, have the run of the pasture the next summer, and after the second Christmas are broken into the yoke. The custom of breeding *in and in* is not generally practised in Sussex, under the impression that the stock degenerates. They therefore change the bull every two years, and thus avoid affinity. This is in direct opposition to the practice of Bakewell and the modern school after him; and possibly the Sussex breeders may, since Youatt's time (from whom we quote), have changed their system.

The Sussex breed of oxen is spread over the adjoining county of Kent, but not more as dairy stock than in their own county. In the Weald of Kent they are kept for breeding; grazing cattle only, and the young stock, are turned into the Romney Marshes in the summer, where they remain from the middle of May to the end of September. They are then put into the pasture to eat up the remainder of the summer's grass, and in winter are kept in the straw-yard, or receive hay in the field. In exchange, the Romney Marsh farmers send their sheep to be wintered in the Weald, from September to April. Kent, however, is neither a breeding nor a dairy county. Polled Scots (Galloway) and Welsh are purchased for grazing, and the best of the heifers are selected for the dairy. But the farmers seldom keep more cows than are sufficient to supply their families with milk and butter.

SECTION XVI.

THE MIDDLE HORNS.—6. THE WELSH CATTLE.

It is, as Youatt states, owing to the fact that the Welsh were never subdued by the early invaders of Britain, that they retained for so long a period their native breed of cattle. Shut in as they were by their barren mountains from intercourse with England, speaking a different language, and being excessively jealous of their liberty and nationality—which latter is as strong in them to this day as ever—they had no desire, if they had the opportunity, of introducing any other domestic animals than they possessed;

* Youatt, p. 42

nor were any others fitted to the country or climate, except the Scotch cattle, which, in fact, were very similar in their form. It appears from history, that the principal colour of the Welsh cattle was "white, with red ears," which corresponds with the description of the wild cattle of Chillingham Park. It is recorded, at an early period, that "a hundred white cows with red ears, or a hundred and fifty black ones," were demanded as a fine for certain offences against the princes both of North and South Wales; and the same number and description of cattle were rendered in homage by the Cambrian princes to the King of England, in acknowledgment of his sovereignty; and in Speed's history it is stated that Maud de Breos, whose husband had offended King John, sent him, in order to appease him, "four hundred cows and a bull, all white with red ears." It is clear from these accounts that there were two breeds or varieties of cattle indigenous in Wales; one of which, the white, is now extinct there, and is only to be found in a few of the parks of the nobility, where they are preserved as curiosities. The other, the black breed, still remains in all its pristine purity, only varying in its physical characteristics, with the nature of the district in which it is reared. A few of them are Long Horned; but the Middle Horned mostly prevail, and although smaller, are the most valuable for the country.

The Pembroke breed of oxen is black; but some of them have white faces or tails, and white horns, which form a graceful curve different from any other breed. They differ also from the Welsh cattle in other parts of the principality in the shortness of their legs, and in their round deep carcases. Their coats are short and curly, their eye lively and good-natured, their hide thin, their bones moderately small, and they fatten quickly. The cows are good milkers, and are reckoned the best of any breed for the cottager. It is, indeed, called "the poor man's cow;" but is equally profitable for the larger farmer's dairy. The same variety is spread over the counties Carmarthen, Cardigan, Brecon, and other adjoining ones, where they are crossed with, and improve, the varieties peculiar to each. They are reckoned to bear a strong resemblance to the Kyloes of Scotland. The meat of the Pembroke cattle is finely marbled, and equal to that of either the Galloway, Scot, or the Devon. They are hardy, and will pick up a living where a Long or Short Horn would pine away; but they pay well and speedily for good feeding.

The oxen are equal to the Devon at agricultural work, whether at plough or on the road with a load; and when turned out of the team fatten very fast. They are naturally more precocious than most other breeds, assume the character of the ox at three years old, and are ready for the butcher at four, without any extraordinary high feeding. Great numbers of them are brought to the London market, where they are readily bought by the butchers, on account of their generally opening well, and showing a large amount of tallow.

The Glamorgan cattle were originally of a reddish hue, indicating an affinity to the Devon and Norman breeds—the latter introduced there by Robert Fitzhamon, a Norman knight in the twelfth century; at least, so say the old historians. At the beginning of the eighteenth century they were described by a Welsh topographer as being of a large size; some red, some pied, and having a sleek coat and a fine head. The Devons were introduced into Glamorganshire by Sir Richard Grenaville of Bideford Castle, according to the same authority; and this is substantiated by the perfect similarity of the present race to the Devon in the horns, the countenance, and the form of the head and neck. In the neighbourhood of Aberdare they have retained their colour, but in other parts, by crossings, they have merged into a brown, which continues deepening by repeated mixtures with the native black cattle of Pembroke. In the Vale of Glamorgan is a distinct breed of light red cattle with white faces, which are said to be an indigenous breed of the district. They are smaller than the brown cattle, but are good milkers and quick feeders.

The Glamorgan cattle were great favourites with George III., who was no mean judge of such matters. One of his agents annually visited the principality to select the best cattle he could find, in order to replenish the royal herd. At that period, stimulated by such high approbation, the Glamorgan farmers prided themselves in keeping their breed of cattle pure, admitting no admixture of foreign blood. They were of a dark brown colour, with a streak of white along the back from the shoulder to the tail, and white bellies. They had clean heads tapering from the neck and shoulders, long white horns turning upwards, and a lively countenance. Their dewlaps were small, their hair short and silky. The tail was set on too high above the level of the back to square with the present ideas of perfection of form. They usually ceased working at six or seven years old, and were sent to fatten, which they soon accomplished, on the English pastures. Like the Pembroke cattle, the meat was of the first quality, and the Glamorgans found ready purchasers amongst the butchers, whether in London or the country, on account of the large amount of tallow they produced. The weight of the cows when fattened ranged from eight to twelve score ($11\frac{1}{2}$ to 18 stone of 14 lbs.) per quarter, and the oxen from twelve to eighteen score (18 to 24 stone) per quarter.

The breed of Glamorgan cattle was much neglected during the war at the beginning of the present century, owing to the high price of grain. The farmers found it more profitable to break up their pasture-land and grow corn, than to breed and rear cattle. Sheep were then considered more adapted to the new system than oxen; the produce of the dairy was converted into butter and cheese instead of rearing calves, which were taken from the cow at two or three weeks old, and reared on milk and water, hay tea, and boiled linseed. The steers were put to work at two, instead of three years old, and at four were taken off to be fattened. No pains were taken in the selection of breeding cattle; and the consequence was a great deterioration in their character. They became flat-sided, sharp in the hip joints and shoulders, high in the rump (which latter was an indigenous fault), long in the legs, with thick skins, and a weak constitution. Instead of being in request at high rates, as formerly, the breeders could scarcely find customers for them at much reduced prices, and it began to be a losing, instead of a profitable business to rear them.

The farmers now took an alarm, and a few spirited men set about restoring their cattle to their original purity and excellence. This, however, was a work of time and much attention; and, after all, the change in the system of farming left them only the roughest of the pastures, on which to graze their young cattle, the best land having been brought under the plough. The improvement, therefore, was in most cases confined to the adaptation of the stock to the coarser fare to which they were now obliged to submit. A few of the breeders, notwithstanding, persevered in endeavouring to raise their cattle to the original standard of excellence, and have been so far rewarded as to see the improved, or revived pure Glamorgans compete successfully at various local exhibitions of live stock with Short Horns and Herefords. One of the most successful of the farmers in this work of restoration was Mr. David, of Radyr, who received at Sir Charles Morgan's cattle show twelve silver cups for his Glamorgans—which, however, does not speak much in favour of the spirit of improvement in the farmers of the county. We do not find that any of the Glamorgan breed are exhibited at present at either the exhibitions of the Royal Agricultural Society, or at those of the Smithfield farmers' club; nor are there many Welsh cattle of any breeds brought thither.

The fact is, that the most successful of the restorers found it more difficult than they expected to bring back the stock to its original excellence; and every attempt to improve the breed by crossing, first with the Hereford, and then with the Leicester, failed in producing an ox fitted for husbandry so well as the old race, or that would thrive on the rough and scanty pasture on which the native breed had lived. The cause was, both the Herefords and the Leicesters had been accustomed to the richer grazing grounds of their native counties, and their progeny by the Glamorgan cows were of a larger breed than the dams, and required superior feed to what they were brought to. The consequence was, they were found to be sluggish at labour, slow feeders, and coarse in quality of meat. Finding themselves thus foiled in their purpose of breeding for the grazier, and of restoring the old race to its original purity, the farmers determined to establish dairies; and the opening of mines and factories of different kinds afforded a favourable opportunity of disposing of the produce. They, therefore, turned their attention to the Short Horns, but here again they were foiled. The Glamorgan pastures were not rich enough for these cattle, and their milk proved very thin, whilst they were totally unfit for husbandry work, and the oxen would not thrive on the scanty fare the hills afforded. The introduction of the Ayrshire cows was more successful. Breeding from a pure native cow with a cross by an Ayrshire bull, they obtained an animal well adapted to their purpose, being very similar to the Hereford—good milkers, kind feeders, and, though rather smaller than the Herefords, their beef is excellent, the flesh and fat being well laid on upon the best points. We believe that this breed has been kept up for forty or fifty years; and the ready market the dairy farmers find for their produce, both at home and at Bath and Bristol, makes it a profitable business.

The calves are taken from the cow at a week old, and fed with skim-milk. If one appears to fatten kindly, he is prepared for the butcher instead of rearing it for the grazier. Youatt remarks upon the economy of this system as follows:—"Although the calf of the Hereford, or even of the Short Horn, is a very superior animal at a year old, it should not be forgotten that he has probably consumed the whole year's produce of the cow, and that at weaning time he must be supported by the most nourishing food, so that when the balance is struck, the profits of the respective breeders may not be very different, especially if 2 or 3 cwt. of cheese and butter are added to the value of the Glamorgan yearling."

The Glamorgan cattle prevail in the counties of Monmouth and Carmarthen, at least, to a certain extent; but in the Vale district the Herefords were introduced and crossed with them. The Durhams also were brought thither by Sir Charles Morgan, and have effected an improvement in the dairy stock. Most of the cows, however, in the Vale are the Glamorgans, with a few of the Gloucester breed. The husbandry labour of the Vale is chiefly performed by oxen, for which the Glamorgan or the Hereford, or a cross between them, are chiefly employed.

In Carmarthenshire the country is divided into the hill and vale districts. On the hills the cattle are chiefly of Irish extraction; small, coarse, and black, with horns so long and thick as to be scarcely entitled to rank with the Middle Horns. They are hardy enough, and lean, and produce but little milk. The vale cattle are larger, being chiefly Glamorgans crossed with the natives. The Herefords, too, have improved the fattening qualities of the latter, but not for the dairy. They suit the farmer, too, for the yoke or the collar; and, with poor fare, manage to keep up their plight, and do a great deal of work. They begin labour at three years old, but are much less used than formerly. The average produce of a Carmarthen cow is about 1 cwt. of butter in the season, and about double that quantity of cheese. In the richer vale lands on the banks of the streams, a larger quantity of each is made, especially when the meadows have been inundated during the winter.

In North Wales the cattle, though generally small in size, are nearly approaching to the Long Horns; but the hock is the only part about them that gives them any affinity to that race. In Anglesea, Carmarthen, and Merioneth, the rearing of cattle is chiefly attended to; whilst in the counties of Denbigh, Flint, and Montgomery, dairy farms prevail. Formerly it was the practice of the Anglesea breeders, in getting their cattle to market, to drive them across the Menai Strait by swimming, and thousands were annually thus exported, if so we may call it. Of course, many were lost in the dangerous passage, but not so many as the rapidity of the current would lead any one to suppose. The Anglesea cattle are small and black, small boned, deep chested, with heavy shoulders, large dewlap, round carcase, high and spreading haunches, flat face, long horns turning upwards, coarse hair, mellow hide, and, to crown all, a great tendency to fatten. They are chiefly bred for grazing in the midland counties, for the London markets. Their meat is excellent, like all mountain fed meat. Their weight ranges from 60 to 100 st. when fat.

In Montgomery the Devons and Herefords prevail, while in Denbigh and Flint a cross between the old Welsh and the Short Horn has been adopted. The Flintshire cattle are both good milkers and good feeders. Youatt mentions a cow belonging to a farmer at Merthyr, which yielded between the 1st May and the 30th October 4,026 qts. of milk, which produced 358 lbs., avoirdupois, of butter, being nearly 2 lbs. of butter and 22 qts. of milk per day for 183 days successively. Cheese, however, is more the object of the dairy farmers than butter, and as much as 3 cwt. is produced by each cow, the quality being not inferior to that of Cheshire.

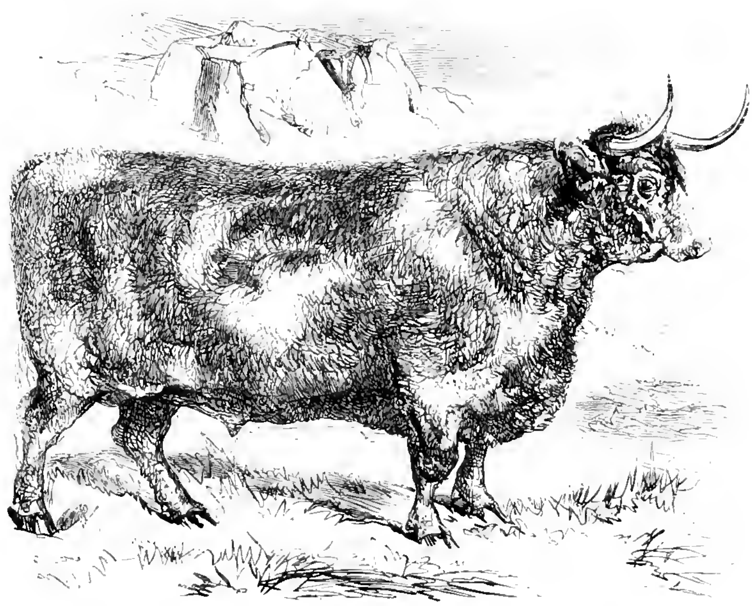
SECTION XVII.

THE MIDDLE HORNS.—7. THE SCOTCH CATTLE.

There are several breeds of cattle reared in Scotland, all of which, with the exception of the Galloways, belong to the Middle Horns; and even the exceptional ones were of that class at the beginning of the last century. We shall commence our description with the West Highlanders, which are found on the islands of the west coast. They are considered to retain the characteristics of the original or primitive race.

The Hebrides, or Western Isles of Scotland, are nearly 200 in number, but only half of them are inhabited. They reach from the Head of Cantyre to the northern extremity of Scotland, and are separated into two groups, the inner and the outer. The inner group are the largest islands, and are mostly separated from the main land by narrow channels. The outer group lies at the distance of thirty or forty miles from the shore. The inhabitants of the Hebrides were originally of the same Celtic race with the Irish and the Scottish Highlanders, mixed with the roving tribes which made incursions upon them. The old legends affirm that the ancient race was never exterminated or lost its identity; and the numerous monuments of their existence prove that at one period the Hebrides were civilised and powerful. "The kingdom of the Innsegallians was the pride of its allies, and the terror of its foes." But the predatory life they were compelled to live, and the continual wars that prevailed, reduced them to barbarism, and for many centuries, and up to a comparatively recent period, "the inhabitants were singularly uncultivated, ignorant, idle, and miserable."

It was after the union with England that the Hebrides began to live anew. Agriculture, which had been neglected, engaged attention; and the cattle, which still retained its characteristics, but had greatly degenerated in size, were now attended to with the view of restoring them to their original excellence, and great numbers were bred. The Island of Islay is particularly noted for the superiority of its race of cattle.



THE HIGHLAND OX.

It is sheltered by its southern position from the storms to which the others are exposed; and its pasturage is better, to which may be ascribed the greater size of its cattle. The Isle of Skye Scots are much smaller, but they are sought for by the Scottish breeders on account of their superior hardiness, which, while it enables them to subsist on scanty fare when young, renders them more susceptible of improvement when brought southward to a richer mode of living.

The term *Kyloe,* which is given to the breeds of cattle in the west of Scotland, is supposed by Sir John Sinclair, and other writers, to be derived from the *Kyloes* or ferries, which the cattle had to cross in that country when taken to market. But others, as Mr. Macdonald, state it to be a corruption of the Gaelic word signifying "Highland," which is pronounced as if spelt *Kael*. The following is the description of the true Kyloe, or West Highland bull of the Island of Islay:—

"The Highland bull should be black, the head not large, the ears thin, the muzzle fine, and rather turned up. He should be broad in the face, the eyes prominent, and the countenance calm and placid; the horns should taper finely to a point, and, neither drooping too much nor rising too high, should be of a waxy colour, and widely set on at the root. The neck should be fine, particularly where it joins the head, and rising with a gentle curve from the shoulder. The breast wide and projecting well before the legs. The shoulders broad at the top, and the chine so full as to leave but little hollow behind them. The girth behind the shoulder deep; the back straight, wide, and flat, the ribs broad; the space between them and the hips small; the belly not sinking low in the middle, yet, in the whole, not forming the round and barrel-like carcase that some have described. The thigh tapering to the hock joint; the bones larger in proportion to the size than in the breeds of the southern districts. The tail set on a level with the back; the legs short and straight; the whole carcase covered with a thick, long coat of hair, and plenty of hair also about the face and horns, and that hair not curly."*

"The value," says Youatt, "of the West Highland cattle consists in their being hardy and easily fed; in that they will live, and sometimes thrive, on the coarsest pastures; that they will frequently gain from a fourth to a third of their original weight in six months' good feeding; that the proportion of offal is not greater than in the most improved larger breeds; that they will lay on flesh and fat equally on all the best parts; and that, when fat, the beef is closed firm in the grain, highly flavoured, and so well mixed, or marbled, that it commands a superior price in every market."†

The number of these cattle is estimated at 150,000 in all the islands. They are kept until five years old, so that one-fifth of them are sent yearly to the main land, either through Jura or by the ferry at the Isle of Skye. They constitute the staple commodity, and the principal agricultural wealth of the Hebridean farmers or graziers. The first English importer of the Western Highland cattle was a Mr. Moorhouse, of Craven, in Yorkshire. This was a century ago; and in the absence of Mr. Macdonald, of Kingsburgh, to whose house he went, he was received by his wife the celebrated Flora Macdonald, who made up for him the same bed in which Prince Charles had slept seventeen years before.

At that period so little attention was paid to the rearing of cattle, that, with the exception of the milch cows, all, even to the calves, were wintered in the fields, and fed with bad hay and what grass the rough pastures and heaths afforded. Of their value on the spot we may judge by the fact, that, on the occasion we have referred to, Mr. Moorhouse purchased 1,600 head at from 2 guineas to £2 5*s*. 6*d*. each. It was said that on an average, one-fifth of them perished every winter of starvation. In some seasons, when the snow lay long on the ground, one half of the stock was lost. Those which survived till the spring soon recovered, and got into a saleable condition.

Great improvements have been effected in the management of cattle in the Hebrides as well as elsewhere of late years. As much as possible the calves are made to come in

* Youatt on Cattle, p. 67. † Ibid.

from February to April. They are all reared, and the first three or four months are allowed to suck three times a day, but a small quantity at a time. In summer the cattle are all in the pastures, and the calves are sent to the cows twice a day. They are only weaned finally at the beginning of October, when those cows intended to be sold, are sent to the Lowland cattle-trysts, from whence the dealers who purchase them take them to the central and southern counties of England. The calves are housed in the beginning of November, and fed on hay and roots until May, at which time all the cattle are turned into the pastures, keeping the different ages separate. The oxen are now sent to market at two, three, or four years old. The heifers are all retained for breeding. Large droves of these cattle are annually sent to the eastern counties of England, occupying weeks, and even months, on the journey. Many are sold before they reach their ultimate destination; but thousands of them are to be seen at the autumnal fairs of Hempton Green and Saint Faith's, in Norfolk, and at the weekly cattle market on Norwich Castle-ditches. They are attended by a native cattle factor with a few herdsmen under him, whose native costume, and Gaelic language and manners, make them objects of curiosity to the Southerners. The cattle are purchased by the Norfolk and Suffolk farmers, matured on turnips and artificial food, and are fit for the butcher early in the spring. Some, however, are kept and given a month's grass to finish them. Formerly they did not exceed 35 st., or at most 40 st. (14 lbs. to the stone) in weight; but the improved breed of Kyloes will now, at five or six years old reach from 60 st. to 70 st. Their very sharp horns and pugnacious temperament render them dangerous associates in the yard with Lowland cattle, and good policy will give them a separate establishment, and so prevent them from keeping their more quiet companions too much on the alert to fatten readily. The Kyloes themselves, on the contrary, coming from a poor to a rich country, show a tendency to improve their opportunities by fattening very fast.

The cows are not reckoned good milkers, and the native farmers only keep enough on hand to supply themselves with the produce. They make from about 20 lbs. to 24 lbs. of butter, and from 80 lbs. to 90 lbs. of cheese per cow in the season. Their dairy management is simple. The cows are driven slowly and quietly to the fold; the wild character of the animals as well as a regard to the quality of the milk show the propriety of this. They are carefully drained to the last drop, not only on account of the superior richness of the latter portion of the milk, but to prevent the speedy drying up of the source. It is conveyed to the house with as little disturbance as possible, and put into vessels of not more than two or three inches in depth. The cream is supposed to rise more rapidly in shallow vessels, and it is removed in the course of eighteen hours. In Arran and Bute, in the Frith of Clyde, the Ayrshire cow was introduced from the neighbouring coast, but in the other Hebridean Islands the Highland cow is still retained. In North Uist and Tyrie the dairy is more successfully followed than in the other islands, on account of the goodness of the grass.

The range of country on the main land over which the Kyloe or West Highland breed prevails, extends from the north bank of the Frith of Clyde, along the whole western coast and across the country to Aberdeenshire. They have, however, been crossed by various other breeds in many parts; and in Ayrshire there is a mixed breed kept for the dairy, besides the native cattle. A good cow of this crossed breed is said to yield five gallons of milk per day for three months after calving, and three gallons for the three succeeding months; and then, for three months more, one and a half gallon per day. The annual return in butter of these quantities of milk is about 250 lbs., or of cheese 500 lbs. This, however, is produced on the most advanced farms, and by the most judicious stock-keepers, and indicates a thorough knowledge of, and attention to, every department of the breeding and feeding of cattle for the dairy, including *stabulation* or stall-feeding during the winter, and also in summer, if the natural grasses fail from drought. Clover and other artificial grasses, or fodder, are employed in such cases, and every means used to keep up the yield of milk.

It is estimated that not less than 30,000 cows are kept for the dairy in Ayrshire, and as many more for grazing purposes. Glasgow, Edinburgh, and other large cities and towns in Scotland, are supplied with butter and cheese from Ayrshire; and from the rich lands on the banks of the Clyde where the same breed of cows are kept, being preferred to all others for the dairy. A large number of calves are also purchased and fattened for the same markets. These are fed with milk alone; and in eight or nine weeks they reach the weight of from 18 to 26 st. exclusive of the offal. The flesh of the calves thus fattened is rich and delicate, and one that may originally be purchased for 8*s.* or 10*s.*, will, in the time stated, realise £7 or £8. Most commonly they are sold at six weeks, and then fetch from £5 to £6.

Aberdeenshire breeds and grazes more cattle than any other district in Scotland, the country being peculiarly adapted to it. The soil and climate varies between the high and the low parts; and the character of the cattle varies with that of the country. On the hills in the interior the pure Highland or Kyloe prevails, unmixed with any other breed, small and not reaching more than 28 st. or 30 st. when fat, in their native pastures, but reaching 40 st. when sent to the south. In the valleys is a distinct breed, the origin of which is not known. Of late years this breed has been most successfully crossed with the improved Durham or Short Horn; and some splendid specimens of this cross have been exhibited at the Smithfield Club Cattle Show of late years. There is an account also of one bred by Lord Kintore, from an Aberdeenshire cow and a Teeswater bull. This noble beast, which was kept until he was rising six, was estimated to weigh more than 180 st. (14 lbs. to the stone) and in every respect preserved his admirable symmetry when fattened up to that weight. His age excluded him from competing for a prize at the Smithfield Club Cattle Show in 1832, but he was afterwards exhibited at that of the Highland Society at Aberdeen. It is a curious fact that if the cross with the Aberdeen and the Short Horn is persisted in, the progeny rapidly degenerates. The breeders of that county, therefore, turned their attention to other crosses, and found that the Fife or Falkland breed possessed the requisite qualifications, being also near in character to the old race, but having smaller bones, cleaner limbs, rounder carcase, wider hips, and being superior in size to the Aberdeen; in addition to which, they were quite as hardy, were docile workers, and excellent milkers. They were, therefore, adopted by the breeders, and became the foundation of what is now considered the Aberdeen native breed.

Of late years, however, this cross breed has again been crossed with the improved Short Horns; and at several of the recent Smithfield Cattle Shows, specimens of the cross have been exhibited that have carried off the first prizes for cross bred cattle. At the show at Baker Street in 1861, Mr. J. Stewart, of Aberdeen, obtained three first prizes for animals of this cross, in three separate classes. All these were favourable specimens of the cross, and excited the admiration of every one who was capable of appreciating their excellencies. Whether the same degeneracy will take place from continuing the cross remains to be proved; but, if this is the case, it may be avoided by only crossing with fresh native cows, and never with the produce. It is remarked that the progeny of the Fife and the Aberdeen cross are less precocious than the pure Kyloe, nor is their flesh so well marbled; but at the proper age they are quite as apt to fatten as others, even on inferior pasture. It is very probable that the cross of this breed with the Short Horn will cause them to mature at an earlier age, as well as attain a larger size. Mr. Stewart's prize cattle were respectively two years and ten months, three years and nine months, and three years and four months old; and the first, a steer, was quite ready for the butcher.

There is a breed of polled cattle in Aberdeenshire which Youatt considers was introduced from Galloway about the beginning of the present century. These cattle are larger than the horned Aberdeens, but not so handsome, and the quality of the meat is not quite so good. The Buchan cattle are another variety of the Aberdeenshire breeds. They are smaller, shorter in the leg, and of a brown colour, some of them being polled. The cows are good milkers, and the oxen fatten up to 50 st. or 60 st. at four years old. Buchan abounds in grass lands, and great numbers of cattle are consequently bred there, which are mostly bought by dealers and taken to the south. Other breeds have been introduced at different times, but it is the opinion of many of the farmers that none succeed better for the dairy than that which they have had the last sixty years, and which originated in the cross between the Fife and the Aberdeen, as stated above. The number of dairy stock (or cows) kept in Aberdeenshire forty years ago was 28,000, and they have probably increased greatly since then to meet the increasing populations of the large cities and towns.

A remarkable instance of the fecundity and early maturity of the Aberdeen cattle was related by Mr. Gordon, in reply to queries circulated by the Board of Agriculture. On the 25th of September, 1805, a calf of five months old, of the small Aberdeenshire breed, happening to be put into an enclosure with other cattle, admitted a male that was only one year old. In the month of June following, at the age of fourteen months, she brought forth a very fine calf; and in the summer of 1807, another equally good. The first calf, after working in the winter, spring, and summer of 1809, was killed in January, 1810, and weighed 55 st. 2 lbs. (14 lbs. each). The second was killed December 16, 1810, aged three years six months, and weighed 56 st.; and on December 30, 1807, the dam, after having brought up these calves, was killed at the age of two years and eight months, and weighed 34 st. the four quarters, sinking the offal."*

Fifeshire has a breed of cattle peculiar to itself, to which the graziers wisely adhere, without seeking by any mixture to effect improvement. They have small horns, pointing upwards, but bending forward from the root. Bones small; limbs short and clean; skin soft; wide between the hocks; ribs narrow, but wide set, and more curved than other cattle. They fatten quickly, and fill up well at all the choice points. They are hardy, fleet, and travel well. When fed for the butcher, they weigh from 35 st. to 65 st.; but some reach 100 st. The cattle are, beyond a doubt, of Highland origin, but they have received a cross from English cattle at some remote period, although, as it is with all local subjects of this kind, different theories are maintained. That they are

* Youatt, p. 109.

essentially different from the cattle of the surrounding districts, is admitted by all who understand their peculiarities, and every attempt to improve them by admixtures has proved unsuccessful.

Ayrshire also has its own breed of cattle, of which it may be proud. The climate is mild and moist, and a considerable portion of the country is in permanent pasture, but the chief part of the lowlands are pasture and crop alternately. Most of the pasture-ground is occupied with dairy stock, the grazing being confined almost exclusively to the fattening of the cows that are past milking. The following is the description of the Ayrshire cow:—"Head small, but rather long, and narrow at the muzzle; the eye small, but smart and lively. The horns small, clean, crooked, and their roots wide apart. Neck long and slender, tapering towards the head, with no loose skin below; shoulders thin; fore quarters light; hind quarters large; back straight, broad behind, the joints rather loose and open; carcase deep, and pelvis capacious, and wide over the hips, with round fleshy buttocks. Tail long and small; legs small and short, with firm joints. Udder capacious, broad and square, stretching forward, and neither fleshy, low hung, nor loose; the milk-veins large and prominent; teats short, all pointing outwards, and at considerable distance from each other. Skin thin and loose; hair soft and woolly. The head, bones, horns, and all parts of least value, small; and the general figure compact and well-proportioned."*

The qualities of the Ayrshire cow, as described by Mr. Aiton, in his "Treatise on Dairies," are as follows:—"Tameness and docility of temper greatly enhance the value of a milch cow. Some degree of hardiness, a sound constitution, and a moderate degree of life and spirits are qualities to be wished for in a dairy cow, and what those of Ayrshire generally possess. The most valuable quality which a dairy cow can possess is that she yields much milk, and that of an oily, or butyraceous, or caseous nature, and that after she has yielded very large quantities of milk for several years, she shall be as valuable for beef as any other breed of cows known, her fat shall be more mixed through the whole flesh, and she shall fatten faster than any other."†

We believe the Ayrshire cow maintains and deserves the above character, but she did not always do so. Until towards the close of the last century, the cattle of that district were diminutive in size, ill-fed, ill-shaped, and bad milkers; their colour was mostly black, with large white stripes along the back, and on their flanks and faces. Altogether, they were as opposite in qualities to the present breed as possible. This is probably the reason why Culley does not notice them in speaking of the Scotch cattle. It is still uncertain how or when the improvement took place, and Youatt says that if it arose from a careful selection of the best of the native cattle for breeding, it is a circumstance unparalleled in the history of agriculture. But he must have overlooked the fact that Bakewell and the Collingses had set the example, and moreover, that the Scottish farmers have shown that they are not behind the Southerners in enterprise or in availing themselves of such notable examples. If, therefore, it was by the means he has suggested that the improvement was effected, it was not altogether a spontaneous or an original idea; at the same time it reflects great credit on the Ayrshire farmers that at so early a period they adopted a system which originated in what the Scotch then called "a foreign country."

Mr. Robertson, however, who wrote "Rural Recollections," states that Colonel

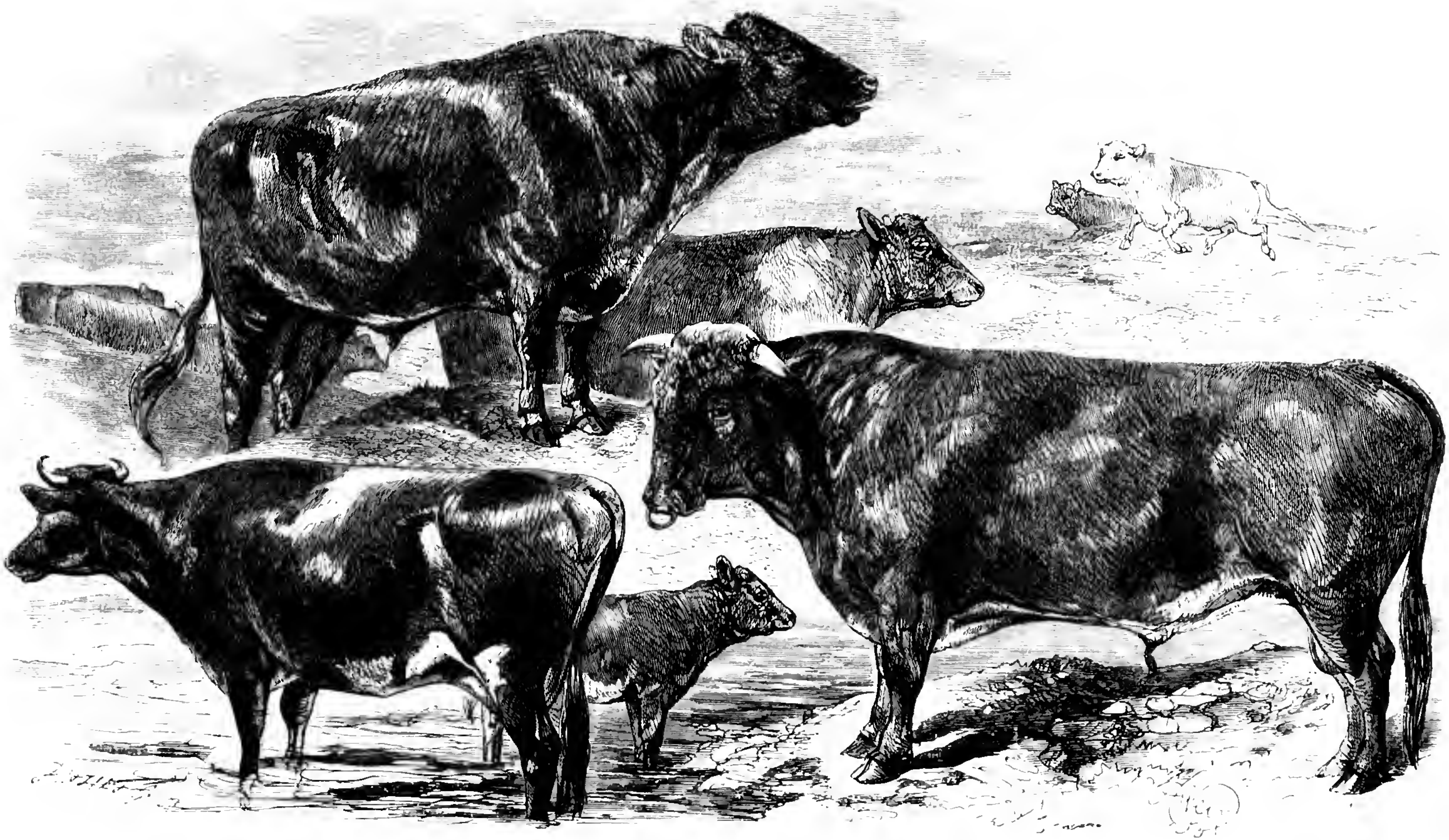
* Youatt, p. 127. † Ibid., p. 128.

Fullarton, on the authority of Mr. Bruce Campbell, ascribes their origin to the efforts of an Earl of Marchmont, who, as Alexander Hume Campbell, married Margaret Campbell, heiress of Assnoch, in Ayrshire, and was made Earl of Marchmont in 1724, and died in 1740, between which dates the improvement took place. Youatt considers it probable that it was effected by a cross of the native cow with a Holderness bull, judging from the varied colour, and, above all, the small head and slender neck.

Be this, however, as it may, the Ayrshire cow is an invaluable animal for the dairy. Four gallons of milk per day is the average for the first three months after calving; three gallons the next three months; and one and a half gallon for four months longer. This is over 850 gallons in the season. The quantity of butter this will yield at the rate of one pound and a half to three gallons and a half of milk is 364 lbs.; or, if we reckon the quantity of milk as averaging 600 gallons (allowing for unproductive cows), 257 lbs. of butter per annum, or 5 lbs. per week the year round, besides the value of the butter-milk and the calf. In converting the milk into cheese, it is estimated that 28 gallons of milk with the cream will make 24 lbs. of cheese, which gives an average of 516 lbs. per annum, besides the whey and the calf.

The Ayrshire cows have been introduced to the London dairies; but they were found not to equal the Short Horns in *quantity* of milk, although the quality was much richer. But quantity is precisely what the London dairymen require from their cows, and therefore the Ayrshire cow is better adapted to the farm dairy, where the object is to obtain as much butter and cheese as possible. The produce of the Ayrshire dairies supplies Glasgow, Edinburgh, and other large cities and towns in Scotland with their produce.

The peculiar adaptation of the Kyloe breed of cattle to the wild and mountainous character of the greater part of Scotland, has doubtless led to its adoption, subject to local modification, throughout the Highlands; whilst its aptitude to fatten has given it an introduction to the graziers of the southern and richer districts, both of Scotland and England. It would be tedious to go through the whole of the counties of the former to point out the minute differences which a variety of soil, climate, treatment, or fancy may have created in the stock. It is agreed by all persons conversant with the subject, that there is what may be termed a family likeness in all the Highland cattle which points to one common origin, which is to be found in that pure breed, the Kyloes of the Hebrides. In speaking, therefore, in the foregoing account of the Middle Horns of Scotland, we have selected only those which, by their peculiar or superior characteristics, are distinguished from their congeners, and render them special objects of attraction to the grazier or the dairy farmer.



SHORT HORNS.

BRETONNE. GALLOWAY. KERRY.

SECTION XVIII.

THE POLLED CATTLE.—1. THE GALLOWAY.

The ancient province or kingdom of Galloway occupies the south-western portion of Scotland, and comprises the shire of Wigton, part of Ayrshire and Dumfries, and the stewartry of Kirkcudbright. The climate of Galloway is mild and moist, and there are many fertile valleys interspersed among the hills, which are not so high or so steep as those in the more northern parts of the country. Wigton and Kirkcudbright are the native district of the *polled, dodded,* or *humble* cattle, called after the name of the province Galloways. It is asserted, and on as good authority as can be obtained, that up to the middle of the last century the Galloway cattle were Middle Horned, with a few polled ones amongst them. Youatt considered that these latter were the mere remnants of a native breed, otherwise the characteristics of the aboriginal breed would be occasionally displayed, although many a generation had passed.

Dr. Coventry asserts that the Horned Galloways of the last century in no respect differed from the Kyloe, and that about the year 1770, some hornless or polled bulls were introduced from Cumberland, with which the native breed was crossed, and the consequence was the loss of the horns by the latter, and at the same time an increase of their size. The improvement thus effected was too great not to be kept up, by selecting the hornless of the progeny for breeding; and it is even alleged that if the incipient horn made its appearance it was cut out with a sharp knife. We would hope, for the sake of humanity, that this latter operation is a flight of fancy.

The Galloway cattle have been favourites with the English farmers, especially those of the eastern counties for nearly 200 years. In an old manuscript accidentally found in the library of the faculty of advocates in Edinburgh written in 1682, is the following account of the Galloway cattle :—"In the parish of Kirkinner (of which the writer, Andrew Symson, was minister) Sir David Dunbar of Baldone hath a park about two miles and a halfe in length, and a mile and a halfe in breadth, the greatest part whereof is rich and deep valley ground, and yields excellent grass. This park can keep in winter and in summer about 1,000 bestiall, part whereof he buys from the country, and grazeth there all winter, other part thereof is of his own breed; for he hath neere 200 milch kine, which for the most part have calves yearly. He buys, also in the summer-time from the country many bestiall, oxen for the most part, which he keeps till August or September; so that yearly he either sells at home to drovers, or sends to Saint Faith's (Norfolk), Satch (or Setch, also in Norfolk), and other fairs in England, about eighteen or twenty scores of the four-year-olds. These of his own breed are very large, and may bring five or six pounds sterling a-piece. Those of his own breed are very large, yea, so large that in August, 1682, nine and fifty of that sort were seized upon in England for Irish cattle (the importation of which was then prohibited); and because the person to whom they were intrusted had not witnesses there ready at the time to swear that they were seen calved in Scotland (although he offered to depone that he lived within a mile of the park where they were calved and reared), they were, by the sentence of Sir J. L—— and some others, knocked on the head and killed; a very hard measure, and an act unworthy persons of that quality and station."

The Galloway cattle are described as straight and broad in the back, and nearly level from the head to the rump. They are round in the ribs, and also between the shoulders and the ribs, and the ribs and the loins. They are broad in the loins without any large projecting hook-bones. In roundness of barrel and fulness of ribs they will compete with any breed, and also in the proportion which the loins bear to the hook-bones or protuberances of the ribs; short in the leg, and moderately fine in the shank bones; the happy medium, says Youatt, seems to be preserved in the leg, which secures hardihood and a disposition to fatten. With the same cleanness and shortness of shank, there is no breed so large and muscular above the knee; while there is more room for the deep, broad, and capacious chest. He is clean, not fine and slender, but well proportioned in the neck and chaps; a thin and delicate neck would not correspond with the broad shoulders, deep chest, and close compact form of the breed. The neck of the Galloway bull is thick almost to a fault. The head is rather heavy; the eyes are not prominent, and the ears are long, rough, and full of long hairs on the inside; the skin is soft and of medium thickness, and covered with long, soft, silky hair. The prevailing colour is black; but some of them are of a dark brindled brown, or with white specks. Culley remarks, in page 60 of his work:—"In most other respects, except wanting horns, the cattle resemble the Long Horns both in colour and shape, only they are shorter in their form, which probably makes them weigh less. Their hides seem to be a medium between the Long and the Short Horns, not so thick as the Long Horns, nor so thin as the Short Horns; but like the best feeding kind of the Long Horns, they lay their fat upon the most valuable parts, and their beef is well marbled, or mixed with fat."

Norfolk and Suffolk are the great marts for the Galloway cattle. Thither thousands of them are driven, to the autumnal fairs, and are purchased by the farmers to be finished off on turnips, hay, and linseed cake. Some, however, are kept over until the summer, when the fattening is completed with two or three months' grass. As they become ready for the butcher they are sent to the metropolis, where they always find ready purchasers on account of the excellence of the meat, and fetch the highest price the market will afford.

The Galloway cows are small, but they give a fair quantity of milk of a very rich quality. The writer once purchased a three year old Galloway cow, with a calf by her side, that had been taken from a drove. She was small, but very gentle, and yielded a fair meal of milk for several months after the calf was taken from her. Most of the heifers, however, are spayed at a year old, and sent with the droves at three years, to be sold for grazing. They fatten faster than the oxen, but do not arrive at so great a weight; yet their meat is considered more delicate, and will fetch a better price.

It is so arranged that the calves should be dropped late in the winter, or, at least, early in the spring; and they are allowed to suck the dam as long as she gives milk. The first four or five months they have a liberal allowance, to the extent of half the milk of the cow, morning and evening. The dairymaid takes the milk from two of the teats, and the calf in the meantime takes care to drain the other two, after which a muzzle, consisting of a ring of leather with some iron spikes in it pointing outwards, is fastened over the nose loose enough to allow the animal to feed on grass. If it attempts to suck, the spikes prick the cow, and she, of course, gives it a kick and sends it off.

The Galloway cattle are not restricted to that ancient province. Great numbers of them are now reared in Dumfries, Renfrew, and other parts. The cows are favourites with the dairy farmers of Renfrew and Ayrshire; but, generally speaking, they are more kept on the muirs and hill sides for rearing stock for the graziers. The value of these cattle on the spot in summer, when they are generally sold, is from £3 to £4 in the second year, from £6 to £7 in the third, and from £10 to £12 in the fourth year, if a lot is taken. They are about three weeks or a month on their passage south, and the expenses of the journey are about £1 4*s.* per head in summer, or £1 15*s.* in winter. If the drover who purchases a large number clears 5*s.* per head *home*, he considers himself remunerated for his trouble. But if farming goes bad, or the turnip crop fails, and the farmers run short of either money or winter food, the drovers frequently sell at a loss proportioned to the extent of their dealings. In some cases they hire rough pasture or heaths, and hold their stock over till the spring, or until they can realise their price. So much, however, is artificial food employed in fattening, and so important is it now considered to raise large quantities of manure, that even a deficient turnip crop does not stop the purchase of the requisite number of cattle to the extent that one would suppose.

A great improvement has of late years been made in the rearing of cattle in Galloway. In winter they are kept in a straw-yard and fed with turnips and dry fodder, whether hay or straw, as the abundance of the one or the other prevails. By this means they attain a larger size, and arrive at market in better condition. They are remarkably quiet and gentle in a yard or pasture with other cattle, and are no match for the Kyloes. In fact, the two ought never to be kept in the same place. The Galloways will fatten up to 50 st. or 60 st. on an average at three or three and a half years old; but some are now fattened up to 100 st. imperial weight, at four or five years old. They are, perhaps, the most uniform in their excellence of any breed of cattle; and, on this account, as well as their other characteristics, they are special favourites with the graziers. A great number are sold at the weekly market on Norwich Castle Hill, which has long been an established mart for all kinds of doméstic animals. The great fairs of Hempton Green, near Fakenham, Saint Faith's, near Norwich, and Setch, near Lynn, are noted resorts of the drovers; and thither the farmers go to make their purchases of stock for winter feeding.

SECTION XIX.

THE POLLED CATTLE.—2. THE NORFOLK.

These are considered to be naturalised Galloways, brought thither as cows in the droves, and crossed with a Suffolk, or some other polled bull. In general they are by no means well shaped, but they are larger, and the cows are excellent milkers. But except in the neighbourhood of Norwich the farmers do not keep many more cows than are sufficient, first to supply the family with milk, cream, and butter, and secondly to enable their wives and daughters to pay the grocer's and linendraper's bills, by the sale of the surplus produce. Some farmers have made attempts to improve the native breed, as it may now be called, and have so far succeeded as to get them much larger; but the specimens exhibited at the Smithfield Club Cattle Show make no figure either as cows or oxen amongst their competitors.

SECTION XX.

THE POLLED CATTLE.—3. THE SUFFOLK DUN.

Many an ancient road-side inn in Suffolk and Norfolk has the dun cow for its sign, proving the antiquity of the breed as well as its celebrity, which once extended over a great part of the kingdom, on account of its extraordinary milking powers. The original dun colour is now seldom met with, which indicates that the breed has been crossed with others. They still, however, maintain their celebrity for the quantity of milk they yield, as well as for the richness of its quality.

The Suffolk, like the Norfolk cattle, are considered to have sprung from the Galloway. They have retained the short legs and the round form more perfectly than the Norfolks, fatten more readily, and attain a greater weight. The following is the description of these cattle a century ago by Kirby, the author of the "Suffolk Traveller:"—"The Suffolk cow has a clean throat, with little dewlap, a snake head, is thin and short in the legs, the ribs springing well from the centre of the back, the carcase large, the belly heavy, the back-bone ridged, the chine thin and hollow, the loin narrow, the udder square, large, loose, and creased when empty, the milk veins remarkably large, and rising in knotted puffs—and this so general, that I scarcely ever saw a famous milker that did not possess this point; a general habit of leanness, hip bones high and ill-covered, and scarcely any part of the carcase so formed and covered as to please the eye that is accustomed to fat beasts of the finer breeds; the general colours are red, red and white, brindled, and a yellowish cream colour. The bull is valued if he is of a pure and unmingled red colour. In no part of the kingdom were the farmers more careless as to the breed, providing only that the cows were true Suffolks. They merely inquired whether the bull came from a dairy of good milkers; and even the cows, which they rarely kept in milk for more than two or three years, they bought at the neighbouring markets and fairs, much oftener than they bred them."

Suffolk is essentially a dairy county, and the produce is converted into butter rather than into cheese, of which we shall have occasion to speak presently. The rich pastures on the banks of the Orwell, the Ouse, the Deben, and other streams, afford ample food for a large number of cows. The milk is divested of all its cream by repeated skimmings, which gave rise to the satirical reference to it of Bloomfield, the Suffolk poet, in his pleasing poem of "The Farmer's Boy." Speaking of the eagerness to obtain as much butter as possible, he says,—

"Hence Suffolk dairymaids run mad for cream,
And leave thin milk, with nothing but its name;
Its name, derision and reproach pursue,
And strangers tell of *three-times-skimmed sky-blue.*"

As to the Suffolk cheese, when we say that it is the produce of the milk thus "thrice skimmed," it will readily be conceived that there cannot be much of the oleaginous principle in it. The same poet has sung its *dispraise* in the following lines in the same poem:—

"Unrivall'd stands thy country's cheese, O Giles!
Whose very name alone engenders smiles;
Whose fame abroad by every tongue is spoke,
The well-known butt of many a flinty joke.
. . . . What can be its boast?
Nought but the common virtues of a post.
If drought o'ertakes it faster than the knife,
Most fair it bids for stubborn length of life,
And, like the oaken shelf whereon 'tis laid,
Mocks the weak efforts of the bending blade;
Or in the hog's-trough rests in perfect spite,
Too big to swallow, and too hard to bite." *

"Suffolk thump," in fact, has, if not a world-wide reputation, at least one co-extensive with the range of its sale; and it is a common saying that it requires "buttering on both sides to make it eatable." The butter, however, in general, is excellent, and from the richness of the pastures and the goodness of the cows, a large quantity is produced. From 50,000 to 60,000 firkins are sent to London yearly, each cow furnishing on an average 3 firkins, or 168 lbs., and ¾ of a wey of cheese, or 260 lbs. The following was Arthur Young's estimate of the produce of a Suffolk cow seventy years ago:—

	£ s. d.
Three firkins of butter, ½ cwt. each, at 32*s*.	4 16 0
¾ of a wey of cheese	1 4 0
A hog	1 0 0
A calf	0 10 0
	£7 10 0

At the present time this produce is of at least double the value. Even in Young's day, he found reason to alter that of the butter and cheese to £8 12*s*. 6*d*., instead of £6, as above. Many of the cows yield a larger quantity of butter than is stated by Young. It is no uncommon thing for a Suffolk cow to yield for many weeks after calving as much as eight gallons of milk per day, and six gallons is a common average.

* A farmer in Cambridgeshire happening to be at Bury fair, purchased a quantity of Suffolk cheeses at the current price (about 2*d*. or 2½*d*. per lb.), thinking they would give a cheap *relish* for his house lads, of whom he kept several. He inquired of his wife from time to time how the lads liked the cheese, and got the reply that they *must* like it, for it went away very fast. Satisfied with the experiment, he contemplated making a larger purchase the next season; until one day, on coming to a gate which was fastened with a pin through the hole of a staple, that passed through the clapping post, he thought there was something very unlike wood about the pin. Upon examining it, he found it was cut out of one of his cheeses; and following up the discovery, he was not a little mortified to find that, not only all the gates with similar fastenings were pinned with the same material, but that the cheese had all been disposed of in any way rather than that for which he had designed it.

If the cows are kept well, they will also give a much greater amount of butter. Youatt mentions three cows belonging to the Rev. Mr. Aspin, of Cockfield, that produced 683 lbs. of butter, from June to December, which was upwards of four firkins each. What is remarkable is, that, in general, the most ordinary looking and cross-made cows are the best milkers. The cows are much better tended than they were sixty years since, and more regard is paid to breeding from the best selections, both of cows and bulls.

The cattle grazed in Suffolk are mostly exotic; generally either Short Horns or Scots, whether Highlanders or Galloways. To these we may add both the young cows that display inferior milking qualities, and the old ones that have passed their prime. However lean and ugly these may be, they fatten very quickly when their milk is dried up. They usually reach 40 st. or 45 st. of 14 lbs. when ready for the butcher. It would appear that their valuable qualities are injured by crossing with any breed whatever. This is certainly the case with a cross of the Short Horn and Suffolk; for although both are good milkers, the produce of the cross was inferior to either breed in that quality. Very few of the calves are reared in Suffolk for grazing.

SECTION XXI.

THE POLLED CATTLE.—4. THE DEVONSHIRE NATS.

There is a breed of Polled Cattle which possess the same characteristics and qualities as the Devon Middle Horns. They have, however, nearly disappeared, and scarcely require any special notice; and the same may be said of the Yorkshire polled cattle, which were (if we are to judge from their size and qualities) a *sport* of the Short Horns of that county and Durham, to which they bear a strong affinity. They both graze well, and are excellent dairy cattle.

SECTION XXII.

THE LONG HORNED CATTLE.

This breed specially belongs to the district of Craven, in that part of the West Riding of Yorkshire bordering upon Lancashire and Westmoreland, and its appearance there goes further back than the authentic or written history of agriculture. There has been a good deal of controversy respecting the origin of these cattle, a similar breed being found in Ireland; and the question is, whether Ireland or England is their native country. It is now utterly impossible to determine this point satisfactorily, nor is it of the slightest consequence; but Youatt inclines to the opinion that at a very remote period they were introduced into Ireland from Lancashire; and he gives as a reason, that whilst the Middle Horns are found chiefly on the mountainous parts of the country, the low grounds are occupied by the Long Horns. We shall have to refer to the Irish cattle again, at the close of this sketch.

It is a singular feature of this breed, that originally the horns projected horizontally from either side of the head, but that as they were improved the horn assumed other directions—sometimes hanging down so low as to prevent their grazing with ease; at others, pointing forward, or curving outwards, and then turning and growing into the cheek, rendering it necessary to cut off the points. These cattle are now extended over several counties, but all persons conversant with them agree in considering the district of Craven to be their original locality; and that, from whatever cause, it is there the best and purest types of the breed are still to be met with, being broader in the chest, better feeders, and more symmetrical in their shape. Those of Lancashire are larger, and more lengthy in the quarters, but have a fall behind the shoulders, and are less level in the chine.

The Long Horns which have been first traced to Craven, have spread themselves gradually along the western coast, and over the midland counties. In Ireland there are at present two distinct varieties, probably arising from the different features of the districts in which they are found. Those on the mountains and moorlands are small, hardy, and useful animals, the cows being much esteemed by the peasant farmers, on account of the cheapness of keeping them, and the quantity and goodness of the milk yielded by them. These cattle fatten fast when put on good pasture, and make excellent beef. Those bred on the low and rich grazing grounds are much larger animals, not equal in milking qualities to the mountaineers, but fatting up to a large size. Both these are considered to be the Craven stock, and have, in many districts of Ireland, been crossed with the old native Middle Horns, and have thus lost their identity.

In England, the Craven breed is found in the counties of Chester, Derby, Nottingham, Stafford, Oxford, and Wilts; but in each of these parts, whether by crossing with the native breeds, or in consequence of the variety of soil, climate, or situation, they have received peculiar modifications; and although in all cases decidedly Long Horns of the original Craven stock, the cattle of each district have their distinguishing features, arising undoubtedly from local circumstances which it would be difficult, if not impossible, and certainly useless, to endeavour to trace.

We can scarcely form an idea of what these cattle were before Bakewell undertook to improve them, on the same principles adopted by him with the Leicestershire sheep. Some hints, however, we may take from Culley's account of what was fashionable with the graziers and breeders previous to that era of cattle rearing. He says (p. 57), "The kind of cattle most esteemed before Mr. Bakewell's day were the large, long-bodied, big-boned, coarse, flat-sided kind, and often *lyery*, or black-fleshed." In a previous page he describes them as "distinguished from others by the length of their horns, the thickness and firm texture of their hides, the length and closeness of their hair, the large size of their hoofs, and coarse, leathery, thick necks. They likewise are deeper made in the fore quarters, and lighter in their hind quarters, than the other breeds in general; they are narrower in shape, less in point of weight than the Short Horns, though better weighers in proportion to their size; and give considerably less milk, though it is said to afford more cream in proportion than that of other cows. They are more varied in colour than any other breeds; but whatever the colour may be, they have (in general) a white streak along the back, which the breeders term *finched*, and mostly a white spot on the inside of the hough."*

Such was the breed upon which Mr. Bakewell undertook to practise the same system he had so successfully adopted with the Leicester sheep. He was followed by Mr. Fowler, of Rollwright, in Oxfordshire; Mr. Princep, of Croxall, Derbyshire; Mr. Paget, of Ibstock, Leicestershire; and Mr. Munday, of Derby; and an important improvement of the breed throughout the country was the consequence; but as soon as the Collingses began their experiments on the Teeswater Short Horns, it became evident that they were far more capable of improvement, and would pay for it sooner and better than the Long Horns. "What," says Youatt, "is now become of this improved breed of Long Horns? Where is it to be found? It was a bold and successful experiment. It seemed for a while to answer the most sanguine expectations of these scientific and spirited breeders. In the districts in which the experiments were carried on, it established a breed of cattle equalled by few and excelled by none, except the Herefords. It enabled the Long Horns to contend, and often successfully, with the heaviest and best of the Middle Horns. It did more; it improved, and that to a material degree, the whole breed of Long Horns. The Lancashire, the Derbyshire, the Staffordshire cattle became, and still are, an improved race—they got rid of a portion of their coarse bone; they began to gain their flesh and fat on the more profitable points; they acquired a somewhat earlier maturity, and, the process of improvement not being carried too far, the very dairy cattle obtained a disposition to convert their aliment into milk while milk was wanted, and after that, to use the same aliment for the accumulation of flesh and fat. The midland counties will always have occasion to associate a feeling of respect and gratitude with the name of Bakewell. The Irish breeders owe everything to the new Leicester cattle. A new stock, in fact, has arisen since the improved Long Horns were grafted on the native Irish stock."†

In seeking the improvement, whether of cattle or sheep, the leading principle that Bakewell kept constantly in the foreground was, beauty of form, or symmetry. With a clear and just idea of the "line of beauty," he connected utility as an inseparable accompaniment. In this, as a general principle, he was proved to be in the wrong, especially if applied to breeding and dairy cattle. With respect to the first, it was found that by persevering in the refinement of the symmetry, reduction of the bone, and the increased tendency to fatten, the constitution was deteriorated, and the power of propagating their species became uncertain, or wholly ceased. Mr. Marshall accounts for this in a very satisfactory way. "The breeder's object," he says, "is to render his bull, to the eye at least, as near perfection as may be; he is therefore made up for the show by high keep, as well to evince his propensity to fatten, as to hide his defects, thereby showing him off to the best advantage; the consequence of which is, that being

* The preference given to size in cattle, rather than to quality, and the total disregard to symmetry, and, consequently, to excellence, is common to all countries where agricultural improvements have not been introduced. Thus, in Austria and the Danubian Principalities, the cattle mostly preferred, are the huge, large-boned, thick-skinned breeds, without any "form or comeliness," only fattening up to a great weight of coarse ordinary beef on the rich pastures watered by the Danube. In some of the remote parts of France, too, the same preference to large breeds of cattle is exhibited; but the exertions of the French government for the improvement of agriculture are gradually extending new ideas on this, as well as on other, subjects of rural economy.

† Youatt, p. 196.

taken from this high keep, and lowered at once to a common cow pasture, he flags. Hence it is become a practice with judicious breeders, when their bulls are let early enough, to lower them by degrees to ordinary keep previous to the season."

The same eminent writer describes the new Leicester cattle, as they were in his time, in the following terms:—

"The fore end long, but light to a degree of elegance; the neck thin; the chap clean; the head fine, but long and tapering.

"The eye large, bright, and prominent.

"The horns vary with the sex, &c. Those of bulls are comparatively short, from fifteen inches to two feet; those of the few oxen that have been reared of this breed, are extremely large, being from two and a half to three and a half feet long; those of the cows nearly as long, but much finer, tapering to delicately fine points. Most of them hang downwards by the side of the cheeks, and then, if well turned, as many of the cows are, shoot forward at the points.

"The shoulders remarkably fine and thin, as to bone; but thickly covered with flesh. Not the smallest protuberance of bone is discernible.

"The girth small compared with the Middle Horn and Short Horn breeds.

"The chine remarkably full when fat; but hollow when low in condition.

"The loin broad, the hip remarkably wide and protuberant.

"The quarters long and level; the nache of a middle width, and the tail set on variously, even in individuals of the highest repute.

"The round bones small, but the thighs in general fleshy; tapering, however, when in the best form towards the gambrels.

"The legs small and clean, but comparatively long. The feet in general neat, and of the middle size.

"The carcase as near a cylinder as the natural form of the animal will allow. The ribs standing out full from the spine. The belly small.

"The flesh seldom fails of being of the first quality.

"The hide of a middle thickness.

"The colour various; the brindle, the finch-back, and the pied are common. The lighter they are the better they seem to be in esteem.

"The fattening quality of this improved breed, in a state of maturity, is indisputably good.

"As graziers' stock they undoubtedly rank high. The principle of utility of form has been strictly attended to. The bone and offal are small and the fore end light; while the chine, the loin, the rump, and the ribs are heavily loaded, and with flesh of the first quality. In point of early maturity they have also materially gained. In general they have gained a year in preparation for the butcher; and though perhaps, not weighing so heavy as before, the little diminution of weight is abundantly compensated by the superior excellence of the meat, its earlier readiness, and the smaller quantity of food consumed.

"As dairy stock their merits are less evident; or rather, it does not admit of doubt that their milking qualities have been very much impaired.

"As beasts of draught, their general form renders them unfit; yet many of them are sufficiently powerful; and they are more active than some other breeds that are used for the plough, or on the road; but the horns generally form an insuperable objection to this use of them."

Besides beauty or symmetry, Bakewell aimed at utility of form, excellence of flesh, and a propensity to accumulate fat; and he selected for breeding cattle which exhibited such qualities, on the principle that only "like begets like," and that generally speaking the children will possess the peculiarities of the parents. Bakewell was, of course, compelled in the first instance to breed "in and in," without regard to near affinity. But there is reason to believe that, after he had raised his stock, he deviated from this as far as possible, or as the principles he had adopted would admit. There is, however, a good deal of mystery about his system, which he does not appear to have fully divulged to his most intimate friends; nor has he left any written memorials behind him to guide those who should follow him in the course of improvement. Marshall appears to have seen and learned more of his system than any other of his contemporaries, being for some years on the most intimate terms with him; but in his own account of him, he states that "it is not his intention to deal out Mr. Bakewell's private opinions, or even to attempt a recital of his particular practice;" and thus, between the modest reserve of the great improver, and the honourable delicacy of his most intimate agricultural friend, the opportunities the latter enjoyed "of making ample observations on Mr. Bakewell's system and practice, and his liberal communications from him on all rural subjects," are lost to the agricultural public.

It appears, however, that Bakewell was not the first man who had instituted an improvement of the Long Horns. So early as the year 1720, a blacksmith and farrier of the name of Welby, residing at Linton in Derbyshire, on the borders of Leicestershire, had a valuable breed of cows, which he had procured from Drakelow House, the seat of Sir Thomas Gresley, on the banks of the Trent, about a mile from Burton. Welby prided himself on keeping his stock pure, and was only foiled in his design by a disease that broke out amongst his cattle; which, by destroying most of them, nearly ruined the owner, and stopped his speculations in improvement.

Welby was soon afterwards followed by Webster of Canley near Coventry, who, procuring some of the Drakelow stock from Sir Thomas Gresley, crossed the cows with Lancashire and Westmoreland bulls, selected by himself. By this means he soon reared the best stock of Long Horns in the country. His bull Bloxedge, "the Hubback of the Long Horns," as Youatt calls him, was the offspring of a three year old heifer by a Lancashire bull; and when a yearling, was so unpromising that Webster sold him to a Mr. Bloxedge; but he afterwards acquitted himself so well as a stock-getter, that Webster repurchased him and used him for several years. The animal finally came into the possession of a Mr. Flavel of Hogshill, where he died. Very little beyond the above is known of either of these pioneers of improvement; but it is not improbable that Bakewell took the hint from them, and basing his own system on theirs, excelled them in the judgment he exercised, as much as in the extent of his operations.

Bakewell's system has been the subject of very severe criticism; and, perhaps, by none more so than by the author of "Illustrations of Natural History." "It was," says this writer, "his grand maxim, that the bones of an animal intended for food could not be too small; and that the fat being the most valuable part of the carcase, it could consequently not be too abundant. In pursuance of this leading theory, by inducing a preternatural smallness of bone, and rotundity of carcase, he sought to cover the bones of all his animals externally with masses of fat. Thus, the entire new Leicester breed, from their excessive tendency to fatten, produce too small a quantity of eatable meat;

and that, too, necessarily of inferior flavour and quality. They are, in general, found defective in weight proportionably to their bulk; and, if not thoroughly fattened, their flesh is crude and without flavour; while, if they be so, their carcases produce little else but fat, a very considerable part of which must be sold at an inferior price, to make candles instead of food, not to forget the very great waste that must ever attend the consumption of over-fattened meat.

"This great and sagacious improver, very justly disgusted at the sight of those huge, gaunt, leggy, and misshapen animals with which his vicinity abounded, and which scarcely any length of time or quantity of food would thoroughly fatten, patriotically determined upon raising a more sightly and a more profitable breed; yet, rather unfortunately, his zeal impelled him to the opposite extreme. Having painfully, and at much cost, raised a variety of cattle, the chief merit of which is to make fat, he has apparently laid his disciples and successors under the necessity of substituting another that will make lean."

There is certainly severity, but there is at the same time much truth, in the above remarks. It has long been the subject of regret, that at our agricultural shows, the cattle exhibited have generally been over fed; and that the loads of fat heaped upon them have set all judgment at defiance as to the shape, make, and symmetry of the monsters of obesity contending for the prize; and this is more reprehensible and injurious when applied, as it too frequently is, to breeding cattle, which is proved by the number of prize cows and others that have slipped their calves, whilst many of the most valuable have died in calving or otherwise. We believe that the exposure of this system, in its consequences, has at length opened the eyes, both of the graziers and of the judges appointed at the cattle shows, to its folly and impolicy; and that, in future, more attention will be paid to form and symmetrical proportion in moderately fed cattle, than to loads of fat, that only serve to hide defects.

It is right, however, to state that Bakewell himself is not answerable for the excesses into which fashion, prevailing since his days, has led his successors. We speak from personal knowledge in stating that at the agricultural shows at the beginning of the present century, the sheep and cattle were *not* fattened to that hideous extent that has prevailed at a later period; and although one of the first principles of Bakewell's system was to secure a tendency to fatten early, and with the least expenditure of food, we are convinced that had he lived to the present day, he would have deprecated the prevailing exaggeration of his system as strongly as any man. The late Earl of Leicester was an ardent admirer and imitator of Bakewell; and at the Holkham sheep-shearings one of the *standing* after-dinner toasts was the memory of Bakewell, coupled with the sentiment or axiom of "*small in size and great in value*," which had reference to the prominence of the best parts of an animal, and the smallness of bone, rather than to the excess of fat.

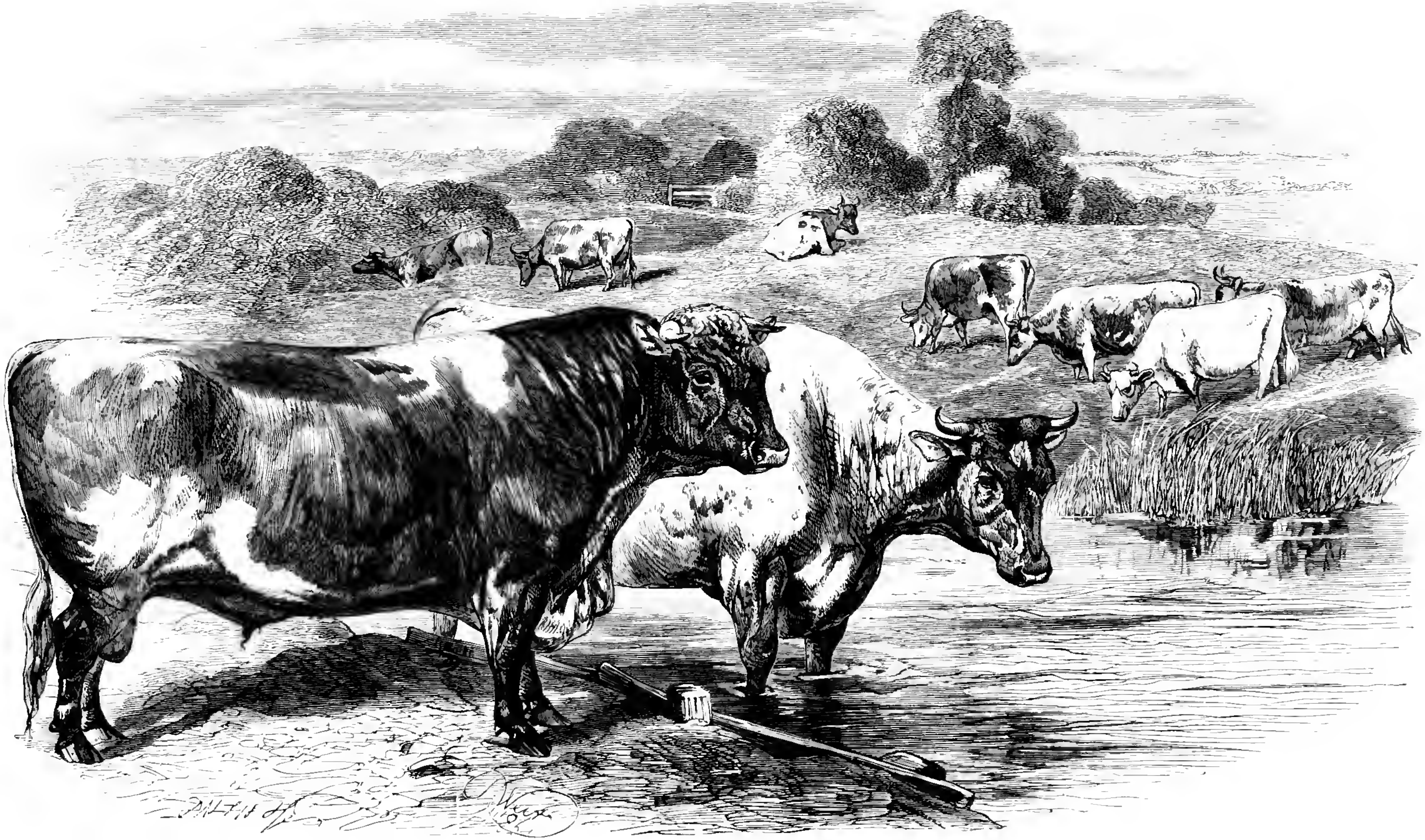
There was one peculiarity in Bakewell's character which all graziers, as well as other persons having to do with cattle, would do well to imitate, namely, his humanity and gentleness to the animals of every description under his care, which was amply repaid by the evident attachment they showed to their kind master. "The gentleness," says a writer in the *Gentleman's Magazine*, "of the different breeds of cattle (belonging to Bakewell), could not escape the attention of any observer. It seemed to run through them all. At an age when most of his brethren are either foaming or bellowing with rage and madness, old C., a bull, a son of the old parent Comely, had all the gentleness of a lamb, both in his look and action. He would lick the hand of his feeder, and if any one patted or scratched him, he would bow himself down almost on his knees." Arthur Young also testifies to the same trait in Bakewell's character:—"Another peculiarity is the amazing gentleness in which he brings up these animals. *All* his bulls stand in the field to be examined. The way of driving them from one field to another, or home, is by a little switch; he or his men walk by their side, and guide them with the stick wherever they please; and they are accustomed to this method from being calves. A lad with a stick three feet long, and as thick as his finger, will conduct a bull away from other bulls, and his cows, from one end of the farm to the other. All this gentleness is merely the effect of management; and the mischief often done by bulls is undoubtedly owing to practices very contrary, or else to a total neglect."

About the same time that Bakewell commenced his experiments upon the Long Horns, the Collingses adopted the Teeswater Short Horns for a similar purpose; with what success, the present state of the herds of Great Britain testifies. In every county in which the Long Horn previously claimed a priority of standing, that race has given way before the evident superiority of its rival; and Youatt affirms that in 1833 there was not one of Bakewell's celebrated improved cattle on the farm at Dishley, occupied formerly by him. That he himself and two or three of his competitors were successful in their system there is no question. At a sale, for instance, of Mr. Fowler's cattle in 1791, six Long Horn bulls sold at from £152 to £250, and six cows from £120 to £273; and the fifty head fetched £4,289 4*s.* 6*d.*, or an average of £85 15*s.* 8*d.* each. Bakewell himself let his bulls at 80 guineas the season; and it was by hiring from him, that Fowler and Princep got into stock.* But as soon as these men passed away, the character which the breed had acquired declined; and the superiority of the Short Horns for the dairy, and their earlier maturity, have given them the preponderance in every county where formerly the Long Horns were universally bred. Not only this, but the improvement effected by Bakewell has to a great extent been lost, and the breed has retrograded towards its original condition, where it is still adhered to. A few breeders do so, and the breed is recognised at the shows of the Smithfield Farmers' Club; but the small number exhibited,† although fine specimens, proves the little esteem in which they are held; and at the meetings of the Royal Agricultural Society, they are not admitted at all as an acknowledged breed.

To give, therefore, a detailed account of each county in which the Long Horns formerly prevailed, would be useless. Wherever they still linger the improved type is nearly lost, and even in Leicestershire it has degenerated (according to Youatt) into the old breed; and it is only in certain localities, to which its peculiarities are best adapted, that it is still retained, and that to a very limited extent. The rich quality of their milk, although it is small in quantity, induces the Cheshire dairy farmers to keep a few of them amongst their cattle; but the Short Horns have in most cases entirely driven them out, and in some of the counties in which they formerly predominated, not one is now seen.

* Some of their stock fattened up to a large size. Lawrence mentions an ox belonging to Mr. Princep, four years old, the weight of which, when killed, was 248 st. the four quarters, besides 25 st. of tallow, all 14 lbs. to the stone; and the hide weighed 177 lbs.

† At the show in December, 1860, there were only three; and in 1861 four exhibited. Of the seven, four were from Warwick, two from Derby, and one from Dorsetshire; five of the seven were heifers, the other two, steers.



SHORT HORNS.

SECTION XXIII.

THE SHORT HORNS.

Perhaps there has never been a more decided expression of public opinion in rural affairs, than in the approbation which this universally celebrated breed of cattle has obtained in every part of the civilised world. This cannot be ascribed to any other cause than to the combination of useful and profitable qualities it is found to possess. Nearly a century has now passed since the improvers of the breed—the Messrs. Collings—adopting the principle laid down by Bakewell, fixed upon the Short Horn cattle, whose locality was then on the banks of the Tees (from which they derived the name of "the Teeswater breed"), for experimenting upon in a similar manner to that which Bakewell had adopted with the Long Horns. Not only were they eminently successful, like him, in making a fortune themselves, but a long succession of Short Horn breeders has sustained the reputation these cattle had acquired to the present day; and such is the estimation in which they are held, that they bid fair to supersede every other breed of cattle in those countries adapted to their constitution and other peculiarities. Large fortunes have been, and still continue to be, made by the most eminent breeders; and at the various cattle shows the great preponderance of the Short Horns proves the extent to which the breed now prevails.

The existence of this breed in the counties of York and Durham, carries us back to the earliest period in which we have any account of the cattle of the country. It is supposed that they were originally imported from the western or north countries of the European continent; but this is merely conjecture, founded on the fact that a race similar to it has existed in Holland and Denmark from the earliest period. But at what time they were brought hither, or whether they were imported at all, or were indigenous in the counties in which they prevailed, is totally uncertain. All that is known of them is, that they were valuable on account of their prodigious milking qualities, in which, in their original state, they excelled every other breed; and it is probable that this was the trait in their character that induced the Collingses to adopt them for their experiments in improvement.

The original Short Horn is represented by Youatt as having little besides its milking powers to recommend it. It had large shoulders, a coarse neck, flat sides, and a thick head; all the coarse parts were bulky, and the prime ones reduced in size; "and they were almost the reverse of what the agriculturist would select. They were, however, bulkier than the other native breeds, and better milkers than the generality of the cattle of that day. They would, by dint of feeding, grow to an enormous size; but they had not the aptitude to fatten, nor the early maturity to which they have since been indebted for their triumph over every other breed."

The first person recorded as having attempted an improvement of the Short Horn (according to Culley) was a Mr. Dobinson, who had a farm in the vicinity of the Tees. This person imported some Dutch bulls, with which he crossed his own stock. Culley states that from his own knowledge, Dobinson and his neighbours were noted for having the best bred Short Horns, and that they sold their bulls and heifers at very high prices. "This," he says, "induced some others of less judgment to go over and purchase some bulls, which introduced along that coast the disagreeable kind of cattle, well known to the breeders adjoining the river Tees by the appellation of *lyery* or *double-lyered;* that is, black fleshed, for, notwithstanding one of these creatures will feed to a vast weight, and though fed ever so long, *yet it will not have 1 lb. of fat about it, neither within nor without:* and the flesh (for it does not deserve to be called beef) is as black and coarse-grained as horse-flesh."*

Several other enterprising breeders followed the example of Dobinson, amongst whom the most eminent were Sir W. St. Quintin, of Scampston, and Mr. Milbank, of Birmingham, who, by similar selections and importations of bulls and cows from Holland, produced crosses, which greatly abated the ill qualities of the Short Horns. It is probably upon this partially improved stock that the Collingses based their own experiments, which have eventually produced a complete revolution in the business of breeding and grazing.

It was in the year 1775 that the brothers Charles and Robert Colling, who occupied farms at Darlington, in the rich valley of the Tees, crossed over to Holland, where they purchased some bulls that appeared likely to suit their purpose. These they put to some cows of the best types they could procure of the native Durham or Teeswater Short Horns. Selecting still from the produce, those possessing the most perfect symmetry, and rejecting the inferior, or unsightly, they commenced, after Bakewell's example, to breed *in and in.* The objects they aimed at and accomplished, were, reduction of bone, quickness of growth, perfection of symmetry, aptness to fatten, and a reduction of size. Youatt suggests, rather than asserts, the last particular as forming a part of Collings' plan; and that they effected it at the outset by means of the bull Hubback, which, as the founder of the improved "Short Horn family," has obtained a world-wide notoriety, and whose history is as follows:—

It is uncertain whether Hubback was of full blood; and it is probable that, on one side at least, he belonged to the foreign breed. His dam was the property of a poor farmer who grazed her in the highway. When purchased by Mr. Colling, and put into good pasture, she became so fat that she never after bred. Hubback took after his dam, and displayed such a tendency to fatten, that his value as a bull was of very short duration. Enough, however, of his progeny was procured to establish the fame, and make the fortune of his owner. In size he was below the Teeswater cattle; and the quality of his flesh, hide, and hair, was superior to anything previously produced; and to this day, the most eminent Short Horn breeders are proud to trace back the pedigree of their best cattle to this celebrated animal.

The history of Hubback, as given by Youatt, is worth recording here. Mr. Waistell, of Alihill, used to admire it as he rode past the meadow where it grazed. The owner asked £8 for it, which seemed a high price for a calf. Happening to meet Mr. Robert Colling, he asked his opinion of it, and he acknowledged there were some good points about it. Suspecting from the reserve with which this opinion was expressed that Colling had a mind to the calf himself, Waistell went the next morning, and concluded the purchase of the animal, which was no sooner effected, than Colling arrived for the same purpose. Riding home together they agreed to make it a joint speculation; but a few months after, both owners becoming less sanguine about its merits, they resold it to Mr. C. Colling, who had discernment enough to see its value;

* Culley, pp. 42, 43.

and from that time kept it for his own purposes, not allowing it to cover even the cows of its former owners.

Following strictly the practice of his prototype, Bakewell, Colling persevered in adhering to the stock of his own raising, always selecting from the produce those only that fully met his views. His success soon enabled him to let out his bulls to the neighbouring farmers at high prices. By degrees his fame spread; and about the beginning of the present century, the production of the "Durham ox" brought the "Short Horn" breed into general notice. This famous animal was the produce of a common cow of that breed by Favourite, one of Colling's best bulls. It was sold at five years old to Mr. Bulmer, of Harmby, near Redale, at the price of £140. This was in February, 1801, at which time its live weight was 216 st., the computed weight of its carcase being 168 st. of 14 lbs. Bulmer had a carriage made for it, and exhibited it about the country for five weeks, and then sold it, together with the carriage, to Mr. John Day, of Rotherham, for £250. Day was offered on the same day (14th May) 500 guineas for it; a month after, 1,000; and on the 8th of July £2,000. He travelled with it for six years throughout England and Scotland, till, on the 19th February, 1807, at Oxford, the animal's hip-bone was dislocated, and the impossibility of reducing it, compelled his owner to consent to its being slaughtered; and although it must have lost considerably in weight in the eight weeks from its accident, the following was its dead weight:—

	Stones.	lbs.
Four quarters	165	12
Tallow	11	2
Hide	10	2
Total	187	2

Although Mr. Charles Colling adhered to the breed he had adopted on one side, he tried many experiments in crossing, always choosing those which were smaller than the Short Horns. The most successful of these attempts was a cross with the polled Galloway. A beautiful red cow of this valuable breed was covered by Mr. Colling's Short Horn bull Bolingbroke, and the produce being a bull-calf, it was, in due time, put to Johanna, a pure Short Horn cow, who also produced a bull-calf, who was afterwards the sire of the cow Lady, by a pure Short Horn dam. From Lady has sprung the highly valuable family of improved Short Horns, termed, in reproach, the *Alloy*. How far the *Alloy* was derogatory, let facts testify.*

After a successful career of thirty-five years, the herd of Mr. Charles Colling was sold by auction, and, notwithstanding the prejudice excited against the *Alloy*, the forty-eight lots brought the fortunate owner the large sum of £7,115 17*s.* distributed as follows:—

	£	*s.*	*d.*		£	*s.*	*d.*
17 Cows sold for	2,802	9	0	average	164	17	0
11 Bulls	2,361	9	0	,,	214	13	6
7 Bull-calves	687	15	0	,,	98	5	0
7 Heifers	942	18	0	,,	134	14	0
5 Heifer-calves	321	6	0	,,	64	5	2
	£7,115	17	0	,,	115	8	0

It is further worthy of remark that Lady, at fourteen years old, sold for 206 guineas; Countess, her daughter, ten years old, for 400 guineas; Laura, another daughter, four

* Youatt, p. 230.

years old, for 210 guineas; Major and George, two of her sons, the former three years old, the latter a calf, for 200 guineas, and 130 guineas respectively. His bull Comet sold for 1,000 guineas.

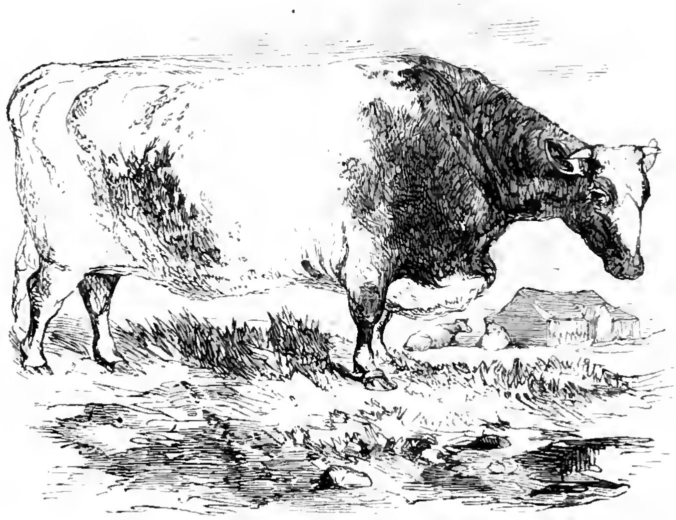
The herd of Mr. Robert Colling was disposed of in the same manner in 1817, when sixty-one head of cattle brought the following sum :—

	Guineas.		£.	s.	d.	
34 Cows	4,141	average	121	16	0	each.
17 Heifers	1,287	"	75	14	0	"
6 Bulls	1,343	"	223	16	0	"
4 Bull-calves	713	"	178	5	0	"
	7,484	"	£121	13	9	"

The extension of this celebrated breed of cattle may be dated from these remarkable sales. Other breeders of celebrity, only second to the Collings, had begun to adopt the same system with the Short Horns. Among these were Mr. Charge, of Newton, Mr. Mason, of Chilton, and Mr. Coates, the latter of whom was the founder of the Short Horn herd-book, by which the pedigree of the breed has been preserved. He had a very superior stock, and sold a bull, Patriot, for 500 guineas. But, fancying his own cattle superior to every other, he would not cross them with any of Mr. Colling's; and the sale of the herd of the latter having established its pre-eminent value, Mr. Coates found his stock fall into disfavour. It would be tedious and useless to follow the history of the Short Horns further. It is sufficient to state that a few years since, it was estimated that there were at least 500 registered herds of them in Great Britain; and, in proof of the firmness with which they have, for a century, maintained their ascendancy over other breeds, at the sale of Short Horns belonging to the late Earl of Ducie at Tortworth, sixty-two animals sold for the enormous sum of £9,361 16*s.* an average of about £151 per head. At this sale several of the descendants of Young Duchess, which was sold at that of Charles Colling's herd for 183 guineas (being only two years old), brought very high prices. Nine animals of the same name, and descended from the same ancestral dam, fetched at Lord Ducie's sale, 4,160 guineas, being an average of over 462 guineas each. One cow, with a bull-calf only six weeks old by her side, were sold for 700 and 310 guineas respectively. This sale is "unparalleled in the past" (as the auctioneer, Mr. Stafford observed), "and probably will never be equalled in the future." The dispersion of such herds, will, of itself, tend to lower the price of the breed, although it will, at the same time, serve to extend its ameliorating influence far and wide. The sale of Master Butterfly (a descendant of Young Duchess) in 1858 for 1,200 guineas to an Australian agent, may be considered the maximum; and although particular animals of high pedigree will still command good prices, it is not likely that such extravagant rates will be submitted to in future, even for the most perfect types, or the most celebrated ancestral descent.

There is, however, not the smallest possibility that the breed will ever go out of favour with the public, or that it can be superseded by one of a superior kind. On the contrary, it is insinuating itself into every country in which domestic animals are kept; and numbers of them are continually being exported to the continent of Europe, the United States, and all the British colonies; and they appear to adapt themselves to every soil and climate, as well as to their native county. In the United States the breed is now found in its greatest purity, the breeders being able to trace the descent of their stock with as much facility as those of England.

The Short Horn cows are known to be the best milkers of any breed whatever, and the London dairymen have now all adopted them to the exclusion of others. It is no uncommon thing for them to yield 30 to 36 qts. of milk per day at the beginning of summer, and the first three months after calving, but the average run is about 22 to 24 qts. The milk is considered to be inferior in richness to that of the Middle Horned cows,* and is therefore better adapted to the London trade than to the dairies where butter is the principal object of production. Yet the Short Horn is gradually superseding other breeds in the cheese districts of Cheshire and other counties. The following description of a Short Horn cow is given by Youatt :—" A milch cow, good for the pail as long as



A SHORT HORNED HEIFER.

she is wanted, and then quickly got into marketable condition, should have a long, and rather small head; a large-headed cow will seldom fatten, or yield much milk. The eye should be bright, yet with a peculiar placidness and quietness of expression, the chaps thin, and the horns small. The neck should not be so thin as that which common opinion has given to the milch cow. It may be thin towards the head; but it must soon begin to thicken, and especially when it approaches the shoulder; the dewlap should be small, the breast, if not so wide as in some that have an unusual disposition to fatten, yet very far from being narrow, and it should project before the legs; the chine, to a certain degree fleshy, and even inclining to fulness; the girth behind the shoulder should be deeper than it is usually found in the Short Horn; the ribs should spread out wide, so as to give as globular a form as possible to the carcase, and each should project farther than the preceding one to the very loins, giving, if, after all, the milch cow must be a little wider below than above, yet, as much breadth as can possibly be afforded to the more valuable parts. She should be well-formed across the hips, and

* Youatt questions this, or, at least, thinks the difference much exaggerated, and that it is more than compensated by the additional quantity, so that more butter will be obtained from a Short Horn Cow, out of a given quantity of food. Experiments have proved, too, that the milk improves in richness as the cow gets older.

on the rump, and with greater length there than the milker generally possesses; or, if a little too short, not heavy. If she stands a little long on the legs, it must not be too long; the thighs somewhat thin, with a slight tendency to crookedness, or being sickle-hammed behind; the tail thick at the upper part, but tapering below; and she should have a mellow hide, and little coarse hair. Common consent has given to her large milk veins; and although the subcutaneous or milk vein has nothing to do with the udder, but conveys the blood from the fore part of the chest and sides to the inguinal vein, yet a large milk vein certainly indicates a strongly developed vascular system, one favourable to secretion generally, and to that of milk among the rest. The udder should incline rather to be large, but not too large in proportion to the size of the animal. It must be sufficiently capacious to contain the proper quantity of milk, but not too bulky, lest it should thicken and become loaded with fat. The skin of the udder should be thin, and free from lumps in every part of it; the teats should be of moderate size, at equal distances from each other every way, and of equal size from the udder to nearly the end, where they should run to nearly a point. When they are too large near the udder, they permit the milk to flow down too freely from the bag, and lodge in them; and when they are too broad at the extremity the orifice is often so large, that the cow cannot retain her milk after the bag begins to be full and heavy. The udder should be nearly equal in size before and behind; or, if there is any difference, it should be broader and fuller before than behind."

Of the superiority of the Short Horns as grazing cattle there is, we believe, no dispute; but it is equally true that they are large consumers of food. The improved Short Horns are precocious; and are ready for the butcher at two and a half or three years old, instead of at five or six, as was the case sixty or seventy years since. The breed is smaller than the old one, and consequently the cattle do not reach the weight. Culley gives the particulars of the weight of two oxen bred and fed by Sir H. Grey, of Howick, Northumberland. They were killed at seven years old, and their four quarters weighed respectively 152 st. 9 lbs. and 152 st. 8 lbs.; the offal weighing 25 st. 9 lbs. and 25 st. 11 lbs. He also mentions another ox killed at Barnstaple at five years old, the four quarters of which weighed 150 st. 4½ lbs., and the offal 26 st. 11 lbs., which brought the entire weight within a little more than one stone of the seven year old. He states, however, that the ordinary weight of the improved Short Horn oxen ranged from 60 to 100 st. (of 14 lbs.) at from five to seven years old. They are now usually brought to that weight at three and four years, and the meat is more tender, if it is not so high flavoured. In Stephen's "Book of the Farm," is the portrait of a Short Horn ox, bred and fed by Mr. Wilson, of Cumleigh, in Berwickshire, which, at the age of one year and eleven months, had attained the weight of 56 st. (of 14 lbs.) according to measurement.

This disposition in the breed to early maturity is indicated by many distinct features in the physical conformation, the following of which are laid down in the work from which we have just quoted:—"The most prominent indication of this disposition is a loose, thick, and mellow skin, as if floating upon a stratum of fat below; and such a skin is invariably covered with long, soft, mossy-feeling hair, bearing a decided colour. A firmness of texture over the whole body is essential to a disposition to fatten. No fat encumbers the bones of the legs or head. All the extremities—the limbs, head, and tail—are small, fine, and tapering from the body. The eye is prominently set in the head, and wears a placid expression; the forehead is broad, the ears are sensible to every near sound; the muzzle is sharp, the nostrils distended, the jaws distinct and clean; the muscles are broad and flat, the blood vessels large and full; the chest is broad, and the tail flat at the top, and broad and tapering to the tuft of hair. The line of the back is straight and level, and the ribs round. A back high above the level is narrow, and is accompanied with flat ribs and a long narrow face, which are both indications of a want of disposition to fatten. When the back is below the level, the fat and flesh are mostly put upon the under part of the carcase, and the tallow increases in the interior. The flanks and cod are then thick and fat. In such a configuration the fore quarters are larger than the hind. Such an animal evinces a disposition to fatten, but lays on coarse pieces. When the curved lines abound over the body and play into one another, giving a brilliancy to the surface, while the sweeping lines of the contour, with the tapering fineness of the extremities, the pleasing countenance and the joyous spirit, a symmetry, state of health, and disposition to improve are conjoined, they afford the highest satisfaction and profit to the breeder."*

THE SHORT HORNED GLOUCESTER.

The Short Horns are varied in their colour, but the roan or brindled is, at the present time, the favourite colour, probably, because several of the finest specimens of the race have lately been of that hue. Dark red is said to indicate a hardy constitution, richness of milk, and disposition to fatten. A light red betokens a good milker as to quantity, but of a thin quality, and little tendency to fatten. White is a sure indication of tenderness of constitution; and although once the favourite or fashionable colour, it has yielded to the roan. The most brilliant of this colour has been the produce of a pure white cow, and a deep red bull; and those who are ambitious of having it in perfection breed from those colours.

Nothing can evince the deep interest felt by the aristocracy of England in the improvement of agriculture so powerfully as the number of noblemen and other persons

* Stephen's "Book of the Farm," vol. ii. p. 708.

of fortune successively engaged in the breeding and fattening of cattle and sheep. Probably this first took its rise towards the latter end of the last century, when George III. set the example by cultivating his farms at Windsor. But the greatest share of the merit is due to the memory of T. W. Coke, the Duke of Bedford, the Earl of Yarborough, and others of their contemporaries, who entered with all the spirit of enthusiastic amateurs into the arena; and ever since their time a succession of men in high life have continued to come forward, sparing neither money nor personal exertion in the promotion of the interests of agriculture. At the head of those of the present day was the late lamented Prince Consort, whose "early, not untimely death," has been the greatest blow that science, art, and industry in every department, have ever received. Strongly attached to the pursuits of rural life, he set a splendid example to those in high rank, and gathered around him a constellation of like minded men, whose efforts in connection with the agricultural institutions of the country, have raised the pursuit to the dignity of a science. We may mention amongst these the late Earls Ducie, Yarborough, and Berners, the late Duke of Richmond, the Duke of Buccleugh, Lords Hill, Burlington, Feversham, Zetland, Sir Charles Knightly, Sir C. Temple, with a long list of wealthy commoners, whose success in the improvement of the various breeds of domestic animals, from the horse to the barn-door fowl, is constantly acting as a stimulus, as well upon their equals in position as on those personally engaged in the pursuits of husbandry. May the time never arrive when the British nobleman and commoner will think it derogatory to their dignity to unite with the enterprising cultivator of the soil in the improvement of the various branches of field enterprise.

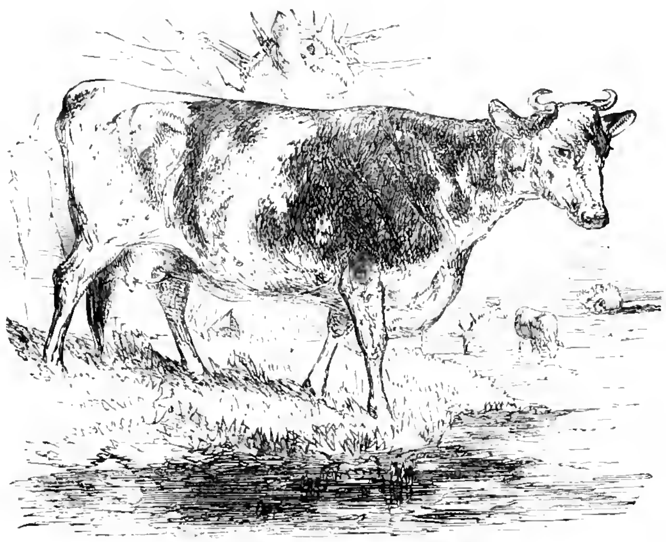
SECTION XXIV.

FOREIGN CATTLE. THE ALDERNEY BREED.

This was originally a French breed of cattle, and has hardly been sufficiently domesticated amongst English herds to give it the title of British produce. Nevertheless it has obtained so strong a hold in the Channel Islands and the neighbouring English coast, and those islands are now so closely identified as a part of the United Kingdom, that we are quite justified in giving it a distinct notice. The Alderney cattle rank in affinity with the Short Horns, but are different in their physical conformation, being angular shaped, small in size, thin necked, small boned, high-shouldered, with a hollow behind them, short in the rump, deep in the belly, and "huge feeders." Their milk is not very abundant, but is excessively rich, which renders them favourites in private families, whilst their gentleness of disposition and small size peculiarly adapt them to the same purpose.

Youatt says that the Alderney cow eats so much, and gives so little milk, that the richness of the quality does not make amends for its cost. On the other hand, old

Lawrence mentions a case of an Alderney cow that strayed into the premises of a farmer, where it remained three weeks before its owner could be discovered; and that during that time it yielded 19 lbs. of butter per week; and that the fact was considered so extraordinary, that a memorandum of it was made in the parish book. They are great favourites with the small dairy farmers of Hampshire, who have facilities for procuring them as well from the coast of Normandy as from the Channel Islands. When dried they readily fatten, being very fine boned; but they only attain a small weight,



THE ALDERNEY COW.

although Martin mentions an ox of this breed, exhibited by the Duke of Bedford at the Smithfield Club Cattle Show, in 1802, the four quarters of which weighed, when killed, 95 stone 3 lbs. (8 lbs. to the stone), and the inside fat, 17 stone 3 lbs.; in all 64 stone 6 lbs. imperial weight. The beef of the Alderney ox is of the first quality, being very fine grained, high coloured, and rich flavoured. Culley says that he had seen some very useful cattle bred from a cross between an Alderney cow and a Short Horn bull.

THE BRETONNE CATTLE.

These gentle little animals, which are scarcely so large as a good sized donkey, have recently been imported in considerable numbers, and have found a ready sale for the use of small private families, for which purpose they are admirably adapted. They are, as their name indicates, natives of Brittany (or Bretagne), a province of old France, lying south-west of Normandy. The cattle are bred on extensive heaths and forests, with which a large portion of the province is covered. They have no distinguishing symmetry or outward marks of superiority to recommend them; but, for their size, they are excellent milkers, yielding from five to six quarts of milk of very rich quality per day for some months after calving, whilst their remarkable docility and gentleness, the very small cost of their keep, and the little trouble they involve, render them a desirable appendage to a private family, especially where they have a paddock or orchard for them to run in. This latter, however, is not necessary, although desirable; for they can be kept in any outhouse, and fed with hay or green food, or roots, which can always be purchased, and will not cost more than 6*d.* or 8*d.* per day. The writer purchased one of these little animals for a gentleman in Ireland a short time since. It is a special favourite with all the family, and will follow them about like a dog, to be fed by hand with a whisp of hay, or a piece of bread, or turnip. For some weeks after calving it yielded seven quarts of excellent milk per day, whilst its keep did not cost more than 6*d.* or 8*d.* per day. The Bretonne cow can scarcely become an object of any value or importance to the English grazier or dairyman, on account of its diminutive size, whilst that feature is the strongest recommendation it possesses for the private family.

SECTION XXV.

ON THE SELECTION OF CATTLE.

The purchase and selection of cattle, of whatever breed, and for whatever purpose has been reduced of late years to what may be called a science. We have already observed that in the early and rude state of agriculture, the eye alone in the purchaser, and size chiefly in the animal, were the means of determining the merits of the subject under consideration; and such is still the case in those countries where agricultural improvement has made little or no progress. A large ox is preferred, however unpromising in other respects, to a small one whose symmetry and well defined excellencies of form indicate a better, quicker, and more profitable result. There is no doubt but that practice, and a keen faculty of discrimination, will enable a purchaser to make a good selection on a *prima facie* view; but no practical man of the modern school will trust to sight alone in the choice of cattle or sheep; he will exercise the sense of feeling as well, and this is a far more demonstrative, but at the same time difficult, acquirement than choosing at sight. Most men possess some idea of the "line of beauty," whether in their own species, or in the inferior animals; but the art of ascertaining by a few slight touches upon certain parts of a bullock or sheep, whether it will lay on fat on the most valuable points, and in the most expeditious manner, can only be acquired by long practice and observation, and cannot be explained or communicated by words from one person to another. "I have often," says Culley, "wished to convey in language that idea or sensation we acquire by touch or feeling of our fingers, which enables us to form a judgment, when we are handling an animal intended to be fattened; but I have as often found myself unequal to fulfil that wish. It is very easy to know where an animal is fattest that *is already made fat,* because we can evidently feel a substance or quantity of fat upon all those parts that are denominated 'the fattening points;' but the difficulty is to explain how we know or distinguish animals *in a lean state,* which will make fat, and which will not; or rather which will make fat on such and such parts or points, and not on others; which a person of judgment (*in practice*) can tell as it were instantaneously. I say *in practice* because I believe that the best judges *out of practice* are not able to judge with precision; at least, I am not. We say 'this beast touches nicely upon its hips, ribs,' &c., &c., because we find a mellow pleasant feeling upon those parts; but we do not say *soft*, because there are some of this same sort of animals which have a soft, loose handle, of which we do not approve, because, though soft and loose, they have not that mellow feel above mentioned. The one will make fat, the other will not."*

It was observed by the same writer that the breeders of his day made a great mistake in breeding neat cattle, by endeavouring to unite great milkers with quick feeders (or fatteners). "I am inclined to think," he says, "that this cannot be done; for wherever we attempt both we are sure to get neither to perfection. In proportion as we gain one, in the same proportion we lose the other. The more milk the less beef, and the more we pursue beef the less milk we get." This is perfectly consistent with reason and analogy, and should never be lost sight of by the breeder or grazier. The Short Horned breed may be thought to disprove this, as they are said to excel any other breed in producing a greater quantity of beef, tallow, and milk from a given quantity of food. This, however, may be an error; for it is well known that the Short Horns are large feeders, and that their milk, though much in quantity is poor in quality. Where they improve in this latter respect they lose their fattening propensity; and if they attain a large size and fatten readily, it is by consuming large quantities of food. In either case, however, they answer respectively the purposes of both the grazier and the dairyman, the object of the first being a quick return for his outlay, and of the second a large meal of milk irrespective of its quality. We close our account of neat cattle with a principle laid down by Culley, with which he also concludes his book:—

"It would seem as though the same principle which we have all along endeavoured to establish held good through all the different classes of domestic animals which supply us with food, viz., that of all animals, of whatever kind, those which have the smallest, cleanest, finest bones, are in general the best proportioned, and covered with the best and finest grained meat. I believe they are also the hardiest, healthiest, and most inclined to feed, able to bear the most fatigue while living, and worth more per pound when dead."†

* Culley on "Live Stock," Introd., p. 14. † Ibid., p. 222.

SECTION XXVI.

THE SHEEP.

The sheep is placed by Linnæus in the genus *Ovis aries,* and in the natural order *Ruminantia* in zoology. They are separated into two general distinctive races—the horned and the hornless. Like the ox the sheep has eight *incisors* or cutting teeth in the lower, and none in the upper jaw; but they are formed differently from those of the ox, having a stronger enamel on the edge, and being grooved in the inside to enable them to crop the herbage close instead of merely tearing it off. Thus the grazing of sheep rather improves than injures a permanent pasture, as by nibbling it close to the root the plant spreads laterally, and becomes a thick and fine herbage of an even and velvety texture.

The lamb when first dropped scarcely shows its incisors, but after a month the whole eight have made their appearance, and they continue to grow till the lamb is termed a hogget, which is at the end of about fifteen months. At this stage, two of the central teeth are shed, and are succeeded by two others, which are fully developed by the time it is two years old from the birth. At three years old two more are set and completed, and so on, until at five years old the animal is what is called "full-mouthed." Circumstances of an accidental kind may hasten or retard this operation, but such cases are exceptional; and, as a rule, the sheep's age may be decided up to five years by the teeth. After that it must be guessed at by other signs.

Culley in his work on "Live Stock," in speaking on the subject of the age of sheep, says, "Respecting the judging of the age of the above animals (viz. the horse and the ox) by the renewing of their teeth, though the best rule perhaps we know of, yet I cannot think it always to be depended on. However, in sheep I am very certain we are very liable to be misled by it, and I apprehend much depends upon being *early* or *late* lambed, well or ill-fed, and so on. Particularly I have frequently known tups to have what we call four broad or renewed teeth, when by the above rule they ought to have only two. A friend of mine, and an eminent breeder, Mr. Charge, of Cleasby, a few years ago, showed a shearling tup at Richmond, in Yorkshire, for the premium given by the Agricultural Society there, which had six broad teeth, in consequence of which the judges rejected Mr. Charge's tup (though confessedly the best sheep), because they believed him to be more than a shearling. However, Mr. Charge afterwards proved to the satisfaction of the gentlemen that his tup was no more than a shearling." *

The age that a sheep will attain is less than that of the horse or the bullock, yet some have been known to reach twenty years; and the mountain shepherds who require *guide-sheep,* or bell-wethers, to lead the flocks amidst the wilds, sometimes keep them to that age; but they begin to *crone,* or to lose their cutting teeth, at a much earlier age, especially the ewes. Yet they will bear lambs until fourteen or fifteen years old, but are seldom kept so long, being in general fattened before losing their teeth, which they do at seven or eight years old.

Whether we consider the sheep in a domestic or a national point of view it is not second in importance to any of those animals that absorb the attention and solicitude of

* Culley on "Live Stock," p. 213.

the farmer. In size it is inferior to the horse or the ox, but its aggregate numbers and the valuable purposes to which the several portions of its frame may be applied, give it a pre-eminence in utility over every other domestic animal. The flesh is the most savonry and digestible of all animal food; its wool clothes every class of society, from the sovereign to the lowest peasant; its skin forms the permanent material on which are inscribed the title-deeds of landed estates; its bones and blood are convertible into valuable manure, &c., and thus every part of the animal finds its use, and contributes in its application to the well-being and the happiness of society.

It would be fruitless to inquire whether the endless varieties of this animal were, as some suppose, derived from one common stock. We know that under one form or other it is found, in all countries and climates, the same useful and docile animal as we see it here. It cannot be doubted that climate and other circumstances of a local and accidental nature, have much influence in modifying the peculiar characteristics of a breed. Thus, for instance, if our finest-woolled sheep are transported to the West Indies, their fleeces will, in a season or two, assume the appearance of hair, losing entirely the more valuable quality of wool. In colder climates than our own, on the other hand, the sheep has an outside coating of hair, and under it another of fine wool, which lengthens and thickens in winter. Difference of pasture also produces similar modifications. It is found that the Merino sheep if put upon rich keeping deteriorates in the character of its wool, while the carcase improves. The extensive and arid plains, therefore, of Australia and the Cape, like those of its native country, Spain, are well suited to sustain the valuable properties of its wool, although in well-cultivated England it gradually becomes coarser.

The terms by which the sheep is distinguished at different periods of its life vary in different parts of the country. Thus the male is usually called a *ram*, or a *tup*. Before being weaned it is a *ram* or *tup-lamb*, a *pur-lamb*, a *heeder*. After weaning, and until it is shorn, it is a *hog*, a *hogget*, a *haggerel*, a *teg*, a *ram-hog*, or a *tup-hog*. If castrated it is a *wether-hog* or *hogget*. After its first shearing it is called a *shearing* or *shearling*, a *shear-hog*, a *diamond* or *dinmont*, *ram* or *tup*; if castrated a *shearling wether*. The wool of the first shearing is called *hogget wool*. After the second shearing it is called a *two-shear ram*, or *tup*, or *wether*; next a *three-shear* ram, &c., and so on as often as it is sheared. In Norfolk and the north of England and Scotland a ram before shearing is a *tup-lamb*, then a *tup-hog* or *hogget*, and after it a *tup*. If castrated it is a *dinmont*, a *wedder*, or *wether*.

The female while sucking is a *ewe-lamb* or a *gimmer-lamb*. When weaned a *gimmer-hog*, a *ewe-hog* or *hogget*, a *teg*, a *sheeder-ewe*. After the first shearing she is a *shearling-ewe* or *gimmer*, and in some places a *theave*, or a double-toothed ewe, or a *teg*. Afterwards she is a *two-shear* or *three-shear*, or a four-toothed, or a six-toothed ewe or theave. In some of the northern districts, ewes not in lamb, or that have weaned their lambs, are called *eild*, or *yeld ewes*. The age of sheep is not calculated from their birth, but from their shearing. This custom probably arose from the different periods of spring at which lambs are dropped, and from the impossibility, as well as inutility, of classifying them according to the exact period of birth. A lamb or a hogget will always sell at a price varying according to its *size*, irrespective of its precise age; and the term *shearling* levels all distinctions of that nature, and leaves the value to be determined by size, condition, &c., &c. A ewe that has what is called a broken mouth, that is, one whose teeth are decayed, or loose, or fallen out, is called a *crone*. In that stage of existence it can no longer scoop out a turnip, and requires to have it sliced, or to have other food.

The care of sheep is by no means a difficult task if the shepherd understands his business and can command his temper. Lawrence quaintly observes, with much significance, that the safest guards for sheep are "*a lame shepherd and a lazy dog.*" In fact a good shepherd will make himself acquainted with the character of every one of his flock; and when this is accomplished he will have little trouble in managing them. We once saw a whole staff of farm labourers endeavouring most ineffectually to *drive* a flock of sheep into a barn in order to mark or dress them. For upwards of half an hour had the men and boys been shouting and jumping here and there, the dogs barking vehemently all the time, and all to no purpose; when at length the shepherd entered the yard. "What are you all after, yer fules?" said he, at the same time driving the dogs away, and directing the men to be quiet. Then placing himself at the barn door, he uttered that peculiar sound which the sheep so well understand, and immediately, without the least distrust or fear, the whole flock followed him bleating into the building.*

The following is Culley's description of a ram, which, he properly says, will apply to all breeds and sizes:—"His head should be fine and small, his nostrils wide and expanded; his eyes prominent, and rather bold or daring; his ears thin; his collar full from his breast or shoulders, but tapering gradually all the way to where the neck and head joins, which should be very fine and graceful, being perfectly free from any coarse leather hanging down; the shoulders broad and full, which must at the same time join so easy to the collar forward, and chine backward, as to leave not the least hollow in either place. The mutton upon his arm, or fore thigh, must come quite to the knee; his legs upright, with a clean fine bone, being equally clear from superfluous skin and coarse hairy wool from the knee and hough downwards; the breast broad and well forward, which will keep his fore legs at a proper wideness; his girth, or chest, full and deep, and instead of a hollow behind the shoulders, that part by some called the fore flank should be quite full; the back and loins broad, flat, and straight, from which the ribs must rise with a fine circular arch; his belly straight; the quarters long and full, with the mutton quite down to the hough, which should neither stand in nor out; his twist (or the junction of the inside of the thighs) deep, wide, and full, which, with the broad breast, will keep his fore legs open and upright; the whole body covered with a thin pelt, and that with fine, bright, soft wool. The nearer any breed of sheep comes up to the above description the nearer they approach towards excellence of form; and there is little doubt but if the same attention and pains were taken to improve any particular breed that has been taken with a certain variety of the Lincolnshire, the same consequences would be obtained."†

The list of "original" breeds of sheep is almost as numerous as that of counties. The old writers afford very little information on the subject, and we must, therefore, accept the statements of comparatively recent ones for the names of those which have been most prominent amongst graziers and breeders. The following is a list of those

* This fact, which is strictly correct, is a striking illustratioo of the words of our Saviour, "And when he putteth forth his own sheep, he goeth before them, and the sheep follow him; for they know his voice. And a stranger will they not follow, but will flee from him; for they know not the voice of strangers."—JOHN x. 4, 5.

† Culley on "Live Stock," pp. 103-4.

which were recognised at the commencement of the present century, and most of which are still admitted at the cattle shows:—

Name of Breed.	Kind of Wool.	Colour.	Horned or not.	Weight of fleece.	Weight of quarter.	Killed at age.
1. Teeswater	Long wool	White face	Horned	9 lbs.	30 lbs.	2 years.
2. Lincoln	,,	,,	,,	11	25	2
3. New Leicester	,, fine	,,	,,	8	22	2
4. Cotswold	,, ,,	,,	,,	9	24	2
5. Romney Marsh	,, ,,	,,	,,	8	22	2
6. Dartmoor	,, ,,	,,	,,	9	25	2
7. Exmoor	,, coarse	,,	,,	6	16	2½
8. Heath	,, ,,	Black face and legs	,,	3	15	3½
9. Hereford, Ryeland	Short wool	White face and legs	Not horned	2½	14	3½
10. Dorset	,,	White and speckled	Horned	3½	18	2
11. Wilts	,,	,, ,,	,,	3	20	3
12. Southdown	,,	,, ,,	Not horned	2½	18	2
13. Norfolk	,,	Black and white	Horned	2	18	3½
14. Herdwick	,,	White and speckled	,,	2	10	4½
15. Cheviot	,,	White face and legs	Not horned	3	16	4½
16. Dun faced	,,	Dun face and legs	,,	1½	7	4½
17. Shetland	,, cottony	Various	,,	1¾	8	4½
18. Spanish	,, super.	White	Horned	3½	14	2½
19. Merino Cross	,, ,,	,,	,,	2¾	16	2

1. THE TEESWATER BREED.

Mr. Culley was of opinion that this breed was originally raised from the same stock as the Lincolnshire sheep, but from attending to size of carcase rather than quality or quantity of wool, they have become a different variety of the same original stock. Nothing is said by ancient historians of the first introduction of this breed; but from a hint dropped in a work by Worledge (written in 1675) about the large size of the Dutch sheep, and the desirableness of obtaining some of the stock, it is not improbable that an importation from that country into the northern counties did take place, by which size and weight were secured. Culley states that Mr. Hutchinson, of Stockton, had a wether killed at Darlington, the four quarters of which weighed 17 stone 11 lbs. (14 lbs. to the stone), or 62 lbs. 4 oz. per quarter, besides 17 lbs. of tallow, which he remarks is the greatest weight, by several pounds per quarter, he ever heard of a sheep weighing. It was of the true old Teeswater breed. A lamb five months old belonging to the same Mr. Hutchinson weighed 22 lbs. per quarter; and four Teeswater sheep gained in fourteen months 458 lbs., or an average of 114½ lbs. each.

Not only were sheep of this breed remarkable for the great weight to which they attained, but they were equally noted for their prolificness. Culley mentions an instance of a ewe of the old Teeswater stock, that in six years brought forth twenty lambs, namely—

In 1772	she	dropped	4	lambs.
,, 1773	,,	,,	5	,,
,, 1774	,,	,,	2	,,
,, 1775	,,	,,	5	,,
,, 1776	,,	,,	2	,,
,, 1777	,,	,,	2	,,
			20	

The first nine lambs were dropped in eleven months: the general run of the ewes average two lambs each.

The Teeswater sheep differ from the Lincolnshire in having shorter wool, and a lighter fleece; in standing higher, but on finer-boned legs, in having a thicker, firmer, heavier carcase, much wider upon the back and sides, and affording a fatter and finer-grained quality of mutton. The weight of the two year old wethers ranges from 25 lbs. to 35 lbs. per quarter; and at four years old some have been fattened up to 55 lbs. or more. They require, however, rich pasture, and not to be crowded too many together. In the Tees valley the land is divided into small enclosures, well sheltered, and of a rich soil. In winter the sheep are allowed access to a haystack, or have hay racks in the field where they are confined, and before and after lambing the ewes have corn given to them. Very few of this race are now to be met with; indeed, it was nearly extinct in Culley's time, the Dishley or New Leicester having supplanted it in almost every district; and it was only retained by a few of the old breeders, who still looked upon size and weight of carcase as the criterion of profitable breeding.

2. THE LINCOLNSHIRE BREED.

This is a very ancient race in that county, and is considered very similar to the Old Leicester sheep, before Bakewell undertook his experiments upon it. The Lincolns are much smaller than the foregoing, the three year old wether weighing only from 20 lbs. to 30 lbs. per quarter. They are distinguished by their thick, rough, white legs, large bones, thick pelts, and, above all, by a fleece of long wool, averaging from 10 to 18

THE LINCOLNSHIRE SHEEP.

inches, and weighing from 8 lbs. to 14 lbs. per fleece. The wool was formerly all sold to the Norwich manufacturers for weaving those coarse fabrics for which that city and the villages in the vicinity were noted, when hand-spinning and hand-loom weaving were prevalent. The present high price of long wool, which is nearly equal to that of the short and finer sort, is beginning to tempt the Lincolnshire farmers to encourage the restoration of their ancient breed of sheep, which is so much better adapted to the soil and climate than any other. They are considered slow feeders, and their mutton is coarse-grained, and their bones large; consequently they fetch less in proportion to their weight than any other breed, yet the weight and value of the fleece is a strong temptation to resume it. In Culley's time the price of the long wool was 10*d.* per lb. whilst, at present, so great is the demand for it on the continent as well as in England, that it has risen to 1*s.* 7*d.*

The defects of this breed of sheep, have, in a great measure, been ameliorated by crossing with the New Leicester or Dishley, by which a finer quality of wool (though a rather lighter fleece), and much better quality of mutton, with a greater disposition to fatten, have been gained. Without sacrificing the peculiarities which render them so valuable in that rich and low-lying district, the cross is distinguished by a cleaner head, a straighter back, and a general improvement in symmetry. There is reason to think that the *original* breed might be improved in the form of the carcase, and in the quality of the meat, without reducing the weight of the fleece, by paying the same attention to the selection of the ram, and breeding only from the best types; in short, by pursuing with them the same course of improvement that Bakewell adopted with the Leicesters without ignoring, as he did, the value of the fleece.

Culley, on the authority of a friend who was a large dealer in *Marsh Sheep,* gives a comparative statement of the product of a full bred Lincoln and one crossed with the Dishley breed, the results of which were as follows:—

Pure Lincoln Breed, sold at Three Shear.

	£	*s.*	*d.*
Three fleeces of wool, 33 lbs. sold at 10*d.* per lb.	1	7	6
Sold at Michaelmas three shear, for	1	15	6
Divide by 3)	3	3	0
Yearly profit . . .	£1	1	0

Crossed with the Dishley Breed, and sold at Two Shear.

	£	*s.*	*d.*
Two fleeces of wool, 18 lbs. at 10*d.*	0	15	0
Sold at Michaelmas two shear, for	2	3	0
Divide by 2)	2	18	0
Yearly profit . . .	£1	9	0

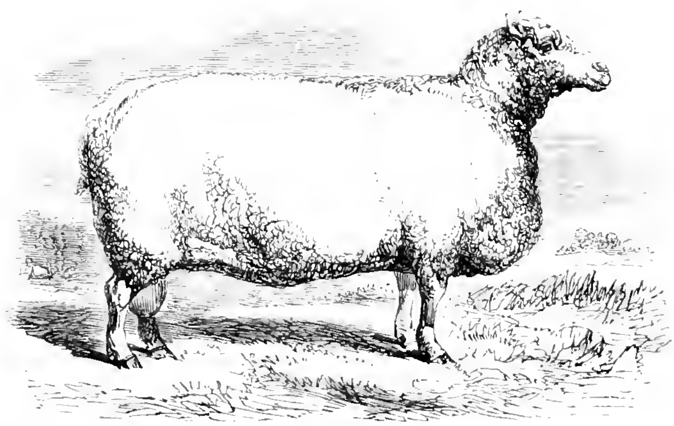
Thus the advantage was 8*s.* in favour of the cross-bred sheep; and this will sufficiently account for the almost total disappearance of the Old Lincolnshire sheep, none of them being ever exhibited at any of the annual shows, either of the Royal Agricultural Society, or of the Smithfield Farmers' Club. The precocity and superior value of the cross breed, and the small difference in the weight of the fleece, are overwhelming reasons for abandoning the old stock, and adopting the half-bred, which is equally suited to the rich marsh lands of Lincolnshire and Kent. Culley considers the pure Lincolnshire sheep to be only a variation of the same race that prevailed in the midland counties, in Marshland (in Norfolk), the Isle of Ely, and the counties of Northampton, Rutland, Leicester, Warwick, Oxford, Gloucester, Stafford, Derby, Nottingham, and the Wolds of Yorkshire. In all these counties the original breeds have disappeared, and the cross-bred sheep are now universally prevalent.

3. THE NEW LEICESTER, OR DISHLEY BREED.

We have already, by anticipation, given an account of Mr. Bakewell's system, so far as it is known, in the improvement of the breeds of cattle and sheep. It is, therefore, unnecessary to go over the ground again, further than to explain the materials on which he instituted his experiments, and the excellencies and defects of the new stock that he raised.

The breed of Old Leicester sheep was by no means despicable, having many good points about it; but, on the other hand, its defects preponderated, and will be duly appreciated when the following description of it is compared with that of the New Leicester, by which it is succeeded. The old breed had a large, heavy, coarse-grained carcase, the mutton ill-flavoured; in form it was long and flat sided, large boned, and clumsy. The weight of the ewes was from 18 lbs. to 20 lbs. per quarter, and of the wethers, from 20 lbs. to 30 lbs. The wool measured from ten to fifteen inches in length of staple, and in quality was generally coarse. They were slow feeders, and made but small returns.* We see here an almost perfect counterpart of the Lincolnshire sheep, being only in a slight degree modified by the effects of local circumstances. On this unpromising animal Mr. Bakewell founded his system of improvement, and the following result showed the excellence of his judgment, and the success of his efforts.

"The Dishley breed," says Culley, "are distinguished from the long-woolled breeds by their fine, lively eyes, clean heads, straight, broad, flat backs, round barrel-like bodies, very fine small bones, thin pelts, and an inclination to make fat at an early age. This



THE NEW LEICESTER SHEEP.

last property is most probably owing to the before specified qualities. . . . . The Dishley breed is not only peculiar for its mutton being fat, but also for the fineness of the grain and superior flavour, above all other large, long-woolled sheep, so as to fetch nearly as much price, in many markets, as the mutton of the small Highland, and short-woolled breeds. The weight of the carcase in general is, of ewes three or four years old, from 18 lbs. to 26 lbs. per quarter; and wethers two years old, from 20 lbs. to 30 lbs. per quarter. The wool upon an average weighs 8 lbs. a fleece, the length from six to fourteen inches, and it sold in 1792 at 10*d.* per lb." †

* Martin on "Sheep," p. 44.

† Culley on "Live Stock," p. 105.

Another writer, Youatt, gives the following account of these sheep forty years afterwards:—"The form is handsome, colour white, their heads are clean and small, their neck short, and their breasts full; their bodies round, with broad, straight backs, but their bellies rather light, or tucked up; their legs and whole bones are fine, and particularly small in proportion to their size; their pelts thin, and the wool long and fine of its kind, generally averaging 7 lbs. to the fleece. They are of a quiet disposition, fatten early and kindly, and are capable of being brought to a great weight on a smaller proportion of food than any other breed of sheep of the same size, the fat wethers weighing generally, when shear-hogs, 25 lbs. per quarter, and the ewes 22 lbs. The flesh is fine-grained and well-flavoured, but too fat to please most palates."

The slaughtering of the New Leicester, wethers at two years old, is now, we believe, the universal practice. With the old breed it was impossible, and even at three years they scarcely made good mutton. But such is the tendency of the Dishley breed to fatten, that at two years they are quite fat enough; and if kept till three years old would be scarcely eatable for fat. Culley mentions a three shear sheep of this breed that when killed at Alnwick, "measured seven inches and one-eighth of solid fat on the ribs cut straight through, without any slope, and his back from head to tail was like the fattest bacon." And he states that even ewes of this breed that have suckled lambs till July, when killed at Christmas frequently measure four or five inches of fat on the sides, and two or three inches down the back, all the way from head to tail, and produce, moreover, from 18 lbs. to 24 lbs. of tallow. A man needs a strong stomach and appetite to dine with complacency on a saddle of mutton from a three shear New Leicester.

It is remarkable that the New Leicesters arrived at a perfection during Bakewell's career that has never been excelled. The writer recollects seeing them at Holkham sheep-shearings nearly sixty years since, and they were the exact counterpart of those exhibited in the present day, nor have the latter degenerated from Bakewell's original stock. Crosses with other breeds, as the Southdown and Leicester, the Cotswold and Leicester, &c., have been made and succeeded well, especially the first, by which a finer quality of wool, as well as of flesh is obtained, while nothing is lost of precocity or general symmetry of form.

Bakewell enjoyed the credit of having instituted the improvement of the Leicester sheep; but he certainly was not the first who made the attempt. A Mr. Allom, who from a ploughboy raised himself by his industry and talent to the position of an eminent farmer and grazier, had distinguished himself by producing a superior breed of sheep. He purchased his ewes in the Melton quarter of his native county, Leicester, and his flock was in high estimation before Bakewell's time, and the most careful breeders resorted to his farm to purchase ram lambs, which he sold at the then extravagant price of 2 guineas and 3 guineas each. Marshall therefore, thinks it probable that by means of Allom's experiments the breed had passed through the first stage of improvement before Bakewell's time.

Another account is given by Pitt, of Wolverhampton, in the agricultural survey of Leicestershire. He states that in 1747 a great rot among the sheep took place, which ruined the small farmers; that the more wealthy ones sent to the high grounds in Yorkshire to purchase a small neat sheep, with which they crossed the few of their own sheep that were left, and produced a useful kind of animal. This they repeated from time to time, the numbers in the first instance being quite inadequate to the demand.

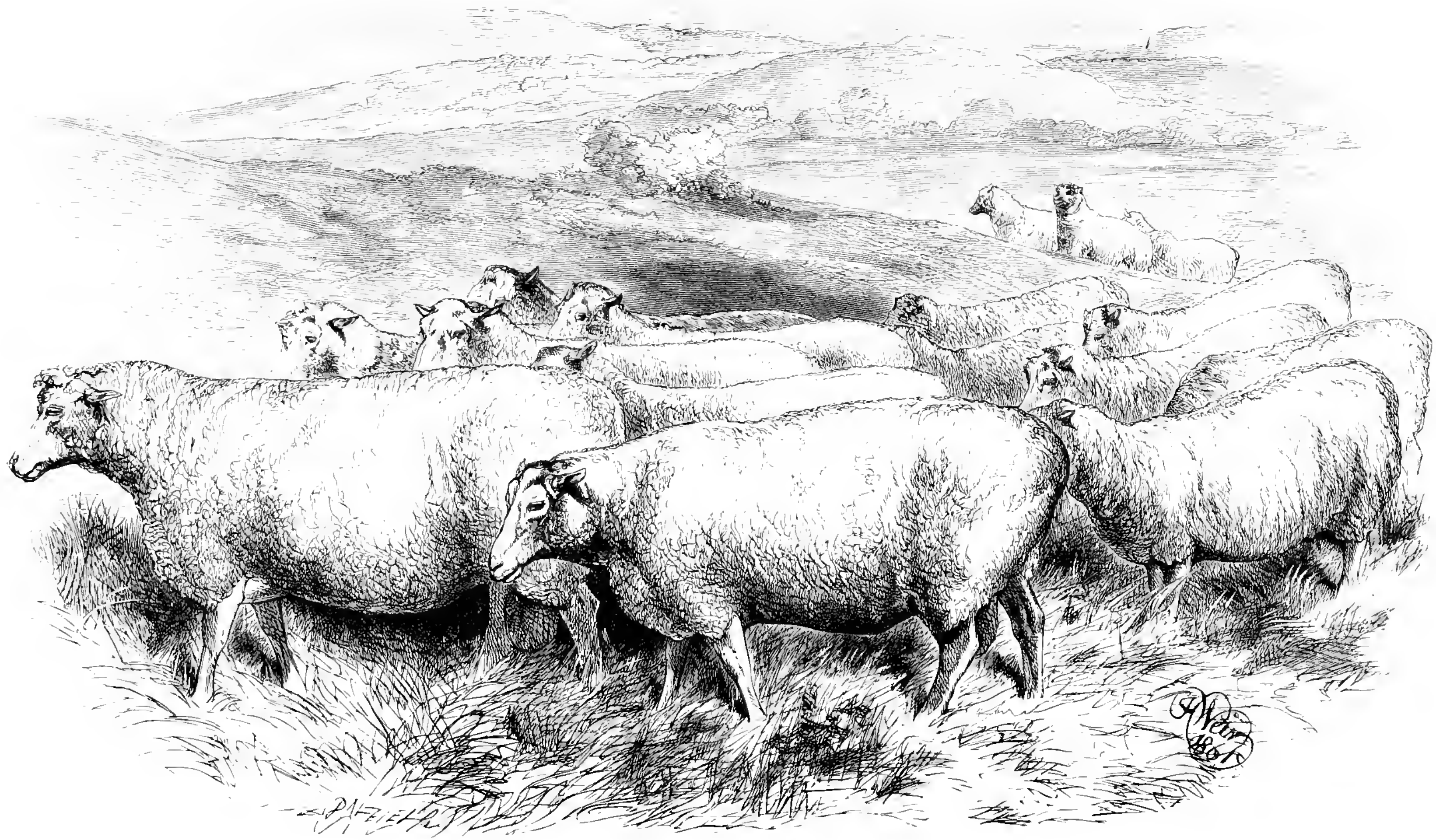
At length a set of jobbers established themselves, for the purpose of supplying the farmers, without the necessity of their going themselves, and thus leaving their business. It is said that Bakewell prevailed on these jobbers to allow him to have the first selection of the sheep they brought, before they were offered to public sale; and it was from these droves, or from the flocks bred in his own neighbourhood, and probably from a cross with the Lancashire, he bred his first short-legged, square-formed sheep, which were so well received, that he went on breeding from his own stock, or crossing with any other that he judged most likely to attain that perfection at which he aimed. Such is Pitt's account of Bakewell's process, and it detracts nothing from the merit he possessed of being the greatest, if not the first, improver of the breed of sheep in his native county.

Hitherto, or before Bakewell's time, the wool was the principal object with the flock-master, and the fattening an *ultimatum*, after four or five years probation in slow feeding; and provided a heavy fleece could be obtained, the defects in symmetry, size of bone, &c., were disregarded. This practice he reversed, and paying no attention to, or at least making a secondary object of the wool, he strove to increase the quantity of mutton and promote early maturity; and for these purposes his discrimination enabled him to see that symmetry, smallness of bone, and aptitude to fatten, were indispensable qualities. Adopting this rule, he soon found it to his advantage; for not only could he keep a much larger number of the improved breed upon a given quantity of land, but he found that the amount of meat produced was much greater in proportion to the food consumed, whilst at least eighteen months or two years were gained in preparing the sheep for the butcher; against which advantages the loss of a few pounds of wool was inconsiderable, and was more than compensated for in the greater number of sheep he was enabled to maintain on a given quantity of land.

While the Dishley breed of sheep are remarkable for laying fat on the outside of the carcase, they do not often *prove* well—that is, accumulate tallow in the inside, which is a loss to the butcher. But, on the other hand, the lightness of some parts of the "offal," the head, the skin, &c., and the greater weight of the carcase than the general appearance of the sheep indicates, compensates for this defect. Perhaps the very early maturity, and fattening propensities of these sheep, may, in some respects, deteriorate the quality and flavour of the mutton, which certainly is inferior in these respects to the Southdown and others of the short-woolled breeds. This disadvantage, however, it has in common with most of the long-woolled sheep,* and its mutton is certainly the best of that race in fineness of grain and flavour.

But the most serious objections to the New Leicester is the defect in prolificness, the consequence of their extraordinary tendency to fatten, which detracts from the strength of their constitution. They seldom produce twins, although Culley, who was contemporary with Bakewell, and adopted his plans on the farm at Fenton, near Wooler, states that in crossing them with the Teeswater breed one-third of the ewes produce twins. Where, however, the Dishley sheep were kept high they were very uncertain breeders.

* "On asking a butcher's wife at Berry, in Suffolk," says Culley, "how she sold mutton? '*five pence a pound, sir!*' answered she, smartly. 'And pray,' I replied, rather surprised at the high price, 'have you no mutton below five pence?' 'Oh yes, sir!' rejoins the honest woman, 'plenty of Lincolnshire at four pence; but we do not account it mutton when compared with our Norfolk and Suffolk mutton.' And if I may be allowed to give my opinion, they would neither of them be accounted mutton in many markets, even further north in this island; the Lincolnshire on account of its coarseness, the other on account of the thinness." Culley was in error as regards the Norfolk sheep, which certainly, however unprofitable, were excellent mutton.



COTSWOLD. LEICESTER. LINCOLN.

The writer had an instance of this on the farm occupied by his father. He had purchased a pure New Leicester ram at a high price, and it certainly was as beautiful an animal as was ever produced; but being put to fifty selected Southdown ewes, the produce was *one* weak lamb! Consequently "Mr. Leicester," as the shepherd styled him, was consigned to the butcher, and the fifty selected ewes, *less one*, were also fattened for the same destination. This tendency, however, did not prevent Bakewell from letting his rams at high prices. Four hundred guineas for the season was no uncommon price; and on one occasion he took in eighty ewes, at 10 guineas each, to be put to one ram, besides forty of his own ewes, so that, reckoning the latter at the same price, he received 1,200 guineas for this one ram for that season. His common price was from 200 to 400 guineas.

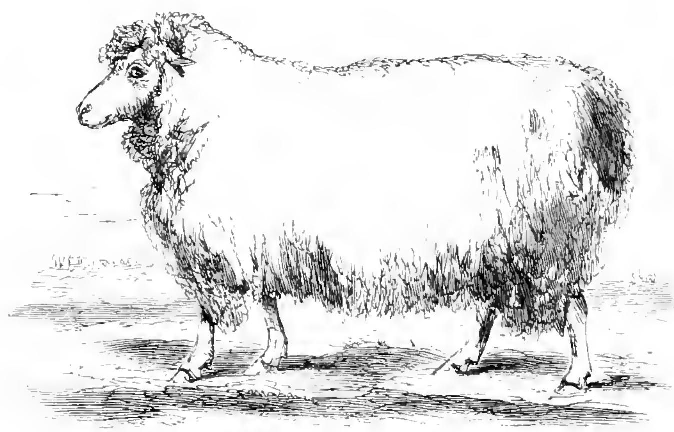
The New Leicesters are a tender breed, and will not thrive on a coarse or scanty pasture, nor would the lambs endure the hardship that a cold, mountainous country would subject them to; they, however, are well calculated to improve the mountain breeds by crossing. Thus the Cheviot cross has been very successful, and the Southdown and Leicester, or Leicester and Southdown, are now established breeds, by means of which a new description of wool, of middle length and great fineness of staple, is procured, which is constantly in demand as a combing wool.

The advantages of the Dishley sheep, then, are—that they produce a greater amount of meat in a given time in proportion to the quantity of food they consume; in their precocity arising from their more perfect form; in the smallness of their bone in proportion to their size of carcase; in being ready for the butcher early in the spring instead of the autumn, by which the summer's grass for them is saved; in the wool being more valuable than that of the Old Leicester breed, although less in quantity; and in the mutton keeping longer, on account of the closeness of the grain, than that of any other sheep of equal size. Their defects are an over-propensity to fatten outside, a deficiency of inside fat or tallow, a tendency to premature decay, and the ewes becoming crones at an earlier age than those of any other breed.

4. THE COTSWOLD BREED.

The Cotswold Hills, in Gloucestershire, from which this breed of sheep takes its name, extend thirty miles in length by about twenty in breadth in some parts, including an area of about 200,000 acres, one-tenth only of which is sheep-walk, the remainder being under cultivation. There are some fertile meadows in the valleys watered by the streams flowing from the high grounds. The Cotswold Hills are a continuation of those of Derbyshire, the great central chain, which, passing through Gloucestershire, loses itself in Wiltshire. The term Cotswold, according to Camden, is derived from the cotes or pens, which from time immemorial have been provided there for the sheep. They consisted of long ranges of buildings of three or four low stories, communicating with each other by means of gradually sloping ascents, so that the sheep easily passed up from the lower to the upper story. The importance and value of such buildings in a mountainous district, especially in the spring and lambing time, when the temperature so frequently changes, cannot be over estimated.

This hardy race of sheep has of late years been brought more prominently into notice by the excellent specimens of the breed that have appeared at the Smithfield Club shows, and those of the Royal Agricultural Society. It is remarkable that Culley does not mention the Cotswolds, from which it would seem that they were not much thought of in his day. Yet the breed is of very ancient standing, and was highly valued on account of the length and fineness of its wool. A flock of Cotswolds were carried into Spain in 1467 by licence of Edward IV.; and an old writer of Queen Elizabeth's time, Gervase Markham, describes them as "a long-woolled, big-boned race." They were flat sided, light in the fore, and heavy in the hind quarters, slow feeders, and covered with a long and valuable fleece of combing wool. The breed has of late years been greatly improved, especially by crossing with the New Leicester, which cross breed is especially esteemed by the Gloucester and Worcester farmers. They are not so tall on their legs, nor so long in their carcase as the old breed, but some of them fatten up to a large size. Some have reached as much as from 40 lbs. to 50 lbs. per quarter at two and a half years old; and their wool, which is finer than any other of the long-woolled breeds, will weigh 11 lbs. to 12 lbs. per



THE COTSWOLD SHEEP.

fleece. The ewes are put to the tup at two years old, and generally produce two lambs in the proportion of one-third of the whole; but they require good keeping. Like the New Leicester, they pay best to fatten at two years old, being apt to get too fat if kept longer.

The Cotswold, either pure or crossed with the New Leicester, has been extended to many other counties than Gloucester of late years, and crossed with various breeds. The Cotswold and Southdown cross is an excellent one. In the valleys of Wales they have been adopted to the exclusion of the native breed, and are found to answer the purpose much better. The Cotswold makes a prominent figure in the shows of the Royal Agricultural Society. At Canterbury there were fifty-seven rams and thirty-five ewes of the breed exhibited; and at Warwick, the year before, a still greater number. Most of the exhibitors were of course Gloucestershire men, but some few of them were from other counties. It is not improbable that the long-woolled breed of sheep on the banks of the Charwell, in Oxfordshire, were a branch of the Cotswold; but these have been superseded by the Leicester and a breed called the New Oxfords, which latter were also probably derived originally from the Cotswold. They have very large frames, which develop themselves rapidly, with a great tendency to fatten. Their symmetry is not equal either to the Cotswold or the Leicester, but on account of their large size the rams are much in request to increase the size of other long-woolled breeds.

5. THE ROMNEY MARSH, OR KENTISH BREED.

This is another branch of the long-woolled race, which has existed in the district from before the time when there were any records of agriculture of a kind to throw light upon its history. We may refer its origin to the same source as the Lincolnshire, namely, the Dutch breed of sheep mentioned by old Worledge, and referred to in our account of the Teeswater sheep. The rich tracts of land in the southern counties of Kent and Sussex are, like the Lincolnshire marshes, well calculated to sustain the breed in all its characteristic size and other qualities, which may be summed up as follows:—A wide loin, a sharp chine, a narrow and rather shallow breast. The belly large; a good cleft; the thigh full and broad, carrying the chief weight in the hind quarters; the tail thick, long, and coarse; the legs thick, with large feet; the muzzle coarse, and the bones large; the wool is of a good combing quality; the fleece of fine wethers from 8 lbs. to 9 lbs.; the mutton is equal to that of any of the large built breeds, and their proof being good, they are favourites with the butchers. When fat, the wethers usually weigh from 35 lbs. to

THE ROMNEY MARSH SHEEP.

40 lbs. the quarter; the ewes from 30 lbs. to 38 lbs. They are hardy animals, bred without much care or expense on wet and exposed land, requiring after the first year (when they are wintered in the uplands) no other food in the severest seasons than occasionally a little hay in addition to their pasture, being fattened entirely on grass.

This breed has of late years been crossed with the New Leicester, by which the sheep have been much improved, though reduced in size, and rendered less hardy, so that heavy losses have been sustained amongst the lambs. As, however, the cross becomes acclimated, the breed recovers its powers of endurance. The original Marsh sheep were never killed until three years old, but the improved breed are fit for the butcher at two years. The cross, however, must be confined to a simple strain; for if repeated upon the progeny, that is if a half-bred ewe be put to a Leicester ram, it would deteriorate the stock, and destroy its hardiness, and increase the tendency to excessive fattening, which should always be guarded against.

Romney Marsh is perhaps one of the richest tracts of pasture land in England. It was reclaimed from the sea, from the encroachments of which it is protected by embankments. It consists of 50,000 acres, and feeds an enormous number of sheep and neat cattle in proportion to its extent. In the winter the upland farmers of Kent and Sussex make an exchange with those of the Marsh, by taking in their sheep on the highlands, and sending them young, lean cattle to feed on the old fog of the Marsh, of which a large quantity is always left after the summer's grazing. By this means the Marsh farmers are freed from the danger of their sheep contracting the rot and the foot-rot, to both of which those of the cross breed were peculiarly liable on the Marsh after heavy rain, although *for a time they fatten faster*. It is said that Bakewell was so well acquainted with this fact, that he was in the habit of flooding his pastures, and immediately after drawing off the water, putting on his sheep, which then contracted the rot, at the same time acquiring fat very fast, so that he had them ready five weeks before his neighbours. This tendency, however, to accumulate fat through disease does not continue, for as the disease progresses the animals become lean again, and waste away rapidly, so that they must be killed in time, or they will be worthless.

6. THE DARTMOOR BREED WITH THE DEVONSHIRE NAT VARIETY.

The Dartmoor sheep are of the hornless race, and have white legs and faces, thick necks, narrow backs, and high back bones; good sides, short legs, and large bones. Culley states that the ewes when fat weigh on an average 26 lbs. per quarter, and the wethers at three and a half years old 20 lbs. per quarter. The wool is of the same combing length as that of the Romney Marsh sheep, and averages in weight 8 lbs. or 9 lbs. per fleece. Formerly the old native race produced neither so much mutton nor so heavy a fleece; but crosses with the New Leicester, and other strains, have much changed the character of the breed. With an improvement in these qualities, however, it has been found that the cross breed is much more liable to disease, such as the rot, the foot-rot, the scour, &c., incident to tender constitutioned animals in cold, wet, and exposed situations, but from which the hardy constitutions of the native sheep exempted them, even when lambs. The mutton of the Dartmoor sheep is much esteemed for its fine gamey flavour, and the richness of its gravy. Since the establishment of railways a considerable quantity of dead meat is sent to the London market, where it finds a ready sale amongst the city gourmands. The country in which they are bred is liable to heavy rains, and the lands become saturated with moisture, very little of it being drained or under culture; yet the native sheep appear not to suffer from it, and are exposed winter and summer to all the inclemency and inconveniences of the seasons without contracting any of those diseases to which the more delicate breeds are so subject under similar circumstances. The summer pasture is scanty, and that of winter necessarily more so; yet these little animals find ways of picking up a living amongst the heather, and are only fed with a little coarse hay in the severest of the weather, or when the snow covers the moors. A tract of this district has recently been enclosed, drained, and brought under cultivation; and having been found amply to repay the outlay, it is probable that in time not far distant, the whole of this dreary and desolate tract will be subjected to the plough.

The Dim-faced Nats are a native Devonshire breed of sheep, having brown faces and legs, crooked backs, flat sides, coarse bones and wool, with a long fleece weighing about 10 lbs. At thirty months the wethers, if fat, average about 22 lbs. per quarter. These sheep have long been crossed with the New Leicester, which has rectified their defects, given them an earlier maturity, and a less weight of carcase and wool. The lambs of the cross breed are more tender than those of the genuine Nats, and require much care and good nursing for some days. The Bampton Nats differ but little from the Dim-faced, except in weighing as much at twenty months as the latter do at thirty, and if kept another year, will reach 28 lbs. per quarter. The crosses of these with the New Leicesters possess the same advantages and disadvantages as those of the Dartmoor; and there appears to be a compensating process in nature by which, either through acclimatisation or other adaptation, a breed of animals suited to soil, climate, or other natural phenomena is found in every part of the world.

7. THE EXMOOR BREED OR VARIETY.

These little animals have curled horns, white faces and legs, fine delicate bones, neat head, and a deer's neck, with a narrow, flat-sided carcase. The weight of the fat wethers at two and a half years is from 15 lbs. to 18 lbs. per quarter. The wool is of combing length, and yields about 4½ lbs. to 5 lbs. per fleece *washed*. They are a hardy race, being much exposed, like the Dartmoor sheep, to the inclemencies of an elevated and moist situation, where there is little or no shelter except the heather with which the moors are covered. The Exmoor sheep have been crossed some years since, with both the Merino and the New Leicester strains. The former cross improved both the quality and the weight of the fleece, so that from an average value of 4*s.* 10½*d.*, the *third* cross with the Merino produced 17*s.* 1*d.*; and it is said that the carcase improved in an equal ratio. The Leicester strain was less successful in the first instance, a considerable number of both lambs and ewes being lost in lambing; but subsequent attempts, notwithstanding the heavy drawbacks in the first instance, have been sufficiently successful to warrant a continuance of the cross.

Some of both the pure Dartmoor and the Exmoor sheep were exhibited at the Christmas show of the Smithfield Farmers' Club in 1861, and excited a good deal of attention by their quaint and primitive manners, if we may be allowed so to express ourselves. Sitting on their haunches like puppy dogs, they eyed the throngs of company with bold and fearless, though wild and apparently amazed countenances, being evidently quite out of their element at Baker Street, but determined to make the best of it under the circumstances. It is probable that when these dreary tracts of moorland are enclosed, drained, and cultivated, the native breeds of sheep will undergo a natural improvement, in accordance with the more abundant and richer supply of food incident to artificial production.

8. THE HEATH OR BLACK-FACED BREED.

The characteristics of this breed are large spiral horns, black faces and legs, a fierce, wild eye; a short, firm carcase, weighing, when as fat as they can ordinarily be made, from 12 lbs. to 16 lbs. per quarter; long, coarse, shaggy fleeces of 3 lbs. or 4 lbs.; hardy constitution, and in every respect well suited to the bleak and wild country in which they are indigenous. These sheep, on their extensive mountainous pastures, are as wild, and almost as fleet, as deer, running with great swiftness at the sight of strangers; and, having no shepherds to control their movements, they range over a large extent of country to pick up the scanty living their barren heaths supply. The true black-faced sheep are said to have a lock of white wool on their foreheads, termed "the snow-lock."

These sheep are found in the north-west of Yorkshire, and on the mountainous district from Lancashire to Fort William, bordering the Irish Sea, and from thence to the western Highlands of Scotland, where they were introduced about the latter end of the last century. Culley, however, considers that the black-faced Linton, or "short sheep" of Scotland, are a variety of the heath sheep crossed with the Cheviot. In fact, there are several varieties of these heath sheep, all of which are well adapted to the countries in which they are found. The greatest defect they possess is the coarse, rugged character of the fleece, and Culley recommended a cross with the Dishley or New Leicester to improve it. "It is disgraceful," he says, "to the rural economy of England, that so excellent a breed of sheep should be needlessly compelled to brave the rigour of the season, in such loose, ragged, beggarly clothing, when they might, with a few years' pains, and without any deterioration of carcase, produce fleeces of high value and consequence to the manufactures of the country." These crosses have been attempted, and have, in most cases, succeeded to a certain extent; but generally speaking the country in which they are found is too barren for the Dishley or any other breed of improved sheep; and the crosses, partaking naturally of the tenderness of constitution of the male parent, are ill-fitted to endure the hardships of a mountain life. The true heath sheep therefore maintains its ground in most of the highland districts, whether of England or Scotland, which will carry no other stock with profit to the owners. Over these they range during the summer months without any shepherd; but, on the approach of winter, are brought down to the enclosed grounds in the valleys, where hay is given to them during the prevalence of the snow, and they are fortified by *salving** against the severity of the winter.

It is said that what are termed black-faced or short sheep, were originally short-woolled, its present length having been produced by crossing. Nor is it properly determined whether Yorkshire or the Scottish Highlands is the original country of the breed. According to the account in the agricultural survey of East Lothian, the common breed of sheep kept in Lammermuir was the black-faced, or what is termed the "brocken" (broken) faced, a sort of dirty-looking mixture of black and white. These sheep were for the most part horned, and when fat, the wethers weighed from 10 lbs. to 12 lbs., and the ewes 8 lbs. to 10 lbs., per quarter on the average. The fleeces were not more than $2\frac{1}{2}$ lbs. in weight of wool, and the quality not very superior, nor was it improved by the salving. The present black-faced breed has been improved by a cross with both the Cheviot and the New Leicester, but the former is the best adapted to the climate and country of the heath sheep.

* Salving is a dressing of tar and butter, or some other unctuous matter which repels the wet and cold.

9. THE RYELAND, OR HEREFORD, AND ITS VARIETIES.

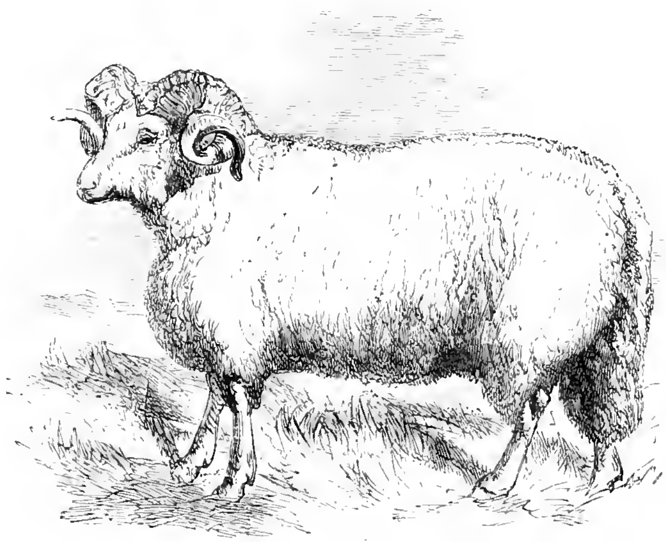
The district from which this breed takes its name, is in the neighbourhood of Ross, in Herefordshire. It belongs to the hornless race, is small in size, with white face and legs, wool growing close to its eyes, small bones, small and clean legs, and general fine symmetry of carcase, the mutton of which is excellent. When fat, the ewes weigh from 9 lbs. to 14 lbs., and the wethers from 12 lbs. to 16 lbs. per quarter. They are generally fit for the butcher at three or four years old. The fleece averages 2 lbs., being short, and finer than any other of our native wools. In the agricultural survey of the district, it is stated that in symmetry of shape, and in flavour and quality of mutton, the Ryeland sheep are superior to any in the kingdom. They are adapted to a down, open country, being patient of hunger, and subsisting on scanty pasture. They require "cotting" in the winter season, and some of the flock-masters cot them at night all the year round, especially in lambing time. They are indifferently a mountain or a vale sheep, and are sometimes fed with the Herefordshire oxen, one sheep being allowed to an ox.

The Ryeland sheep have been crossed with both the Merino and the New Leicester; the former, while it improved the weight and quality of the fleece, very much deteriorated the symmetry and excellence of the carcase. The continuance of the cross has been abandoned since the enormous increase of Australian wool, the quality of which is superior to any of that of the native or crossed breeds of Britain; whilst the increasing demand for long wool, which is not grown to any extent, either in the British colonies or on the continent, has led to the adoption more extensively of the long-woolled breeds of sheep, or of crosses with them, there being now but little difference in the value per pound between the price of the long and the short wool. It is also said that the quality of the wool of the Merino (Ryeland sheep) deteriorated after a few years; but this probably arose from neglect in the breeders, or some other cause, local or accidental, which cannot be accounted for. The cross with the New Leicester has been equally unsuccessful, the product not being so well adapted to the open country as the native breed, which would thrive where a Leicester or a half-bred would starve; and, although the weight of the carcase and of the wool were increased, the quality of the mutton was decidedly deteriorated as well as that of the wool, while the breed itself was less hardy.

The Shropshire *Morfe* is considered a variety of the Ryeland, having fine, short wool, freckled or black face and legs, small bones, and small and clean legs. The Morfe Common contains 3,600 acres, and supports in summer 15,800 sheep, which produce a profit of 15*s.* per acre in wool alone. It appears there are two breeds of sheep on the Morfe, one horned, the other polled, and these have been allowed to blend and produce a cross breed. The horned sheep are very small, and being fed on the mountains, their mutton is exceedingly fine flavoured, and highly esteemed. It comes to London and the nearer large towns of Bath, Bristol, &c., as Welsh mutton, and fetches a high price.

10. THE DORSET BREED.

This is a valuable breed of sheep on account of its producing an early lamb for the London market. They are distinguished by short horns, white faces and legs, long and broad heads with woolly foreheads, shoulders broad at the top, but lower than the hind quarters; backs tolerably straight, deep carcases and broad loins; legs moderately long, but rather coarse in the bone. At three and a half years old the wethers weigh from 16 lbs. to 20 lbs. per quarter; the wool is fine and short. But what distinguishes this from all other breeds, is the peculiar property of producing lambs at any given season, even in September and October, according to the requirements of the flock-master. The fleece weighs from $3\frac{1}{2}$ lbs. to 5 lbs.; the mutton is excellent, and the lamb, from the general habit of rearing it with care for the tables of the wealthy, is first-rate in quality and commands high prices. We have heard of a guinea a quarter being given for house lamb in the early winter. The Dorset breeders take great pains to keep their ewes from any intermixture with the black or brown-faced breed, the *white lamb* being most esteemed by the London butchers on account of its superior delicacy of meat. The ewes mostly bring two lambs at a birth; they suit either the hill or the valley, and their flesh is esteemed as a medium between the highly flavoured and delicate, but dry mutton of the hills, and the juicy and rich lowland mutton.



THE DORSET RAM.

These valuable sheep are to be found in the counties adjoining that of Dorset, especially in the Forest of Dean, and on the Mendip Hills; at least, a valuable variety of the breed—" a small, compact animal, that will thrive on the poorest soil, and fatten on pasture where almost any other breed would starve. Pasture ever so dry and exposed will feed this kind; they are very hardy, their wool fine, and the mutton also is excellent for the table, being full of gravy and of a rich flavour." The Mendip breed resembles in many points the Merinos; and there is a tradition that the original stock of the Spanish fine-woolled sheep was obtained either from those hills, or from the Cotswold Hills in Gloucestershire, but the present breed of sheep in this latter district bears little analogy to the Merino, either in form, size, or quality of wool. The Mendip variety is, perhaps, better suited in these respects to sustain the tradition, but it appears a very unlikely and far-fetched tale.

11. THE WILTSHIRE BREED.

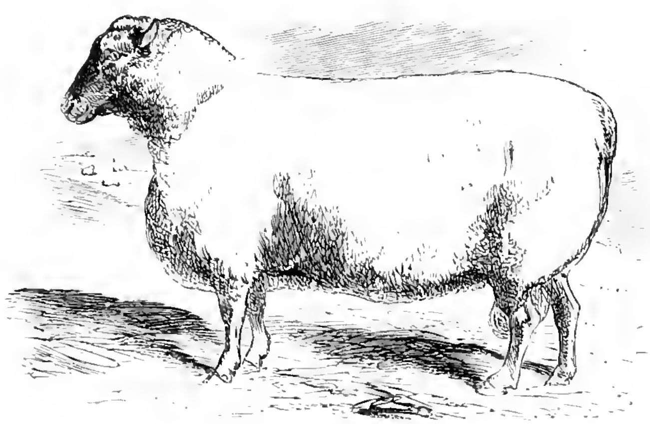
The Wiltshire sheep, although considered separately from the Dorset, are a variety of the same race; but by more attention to the breeding attain a greater size, weighing from 20 lbs. to 28 lbs. per quarter. Thin, large, spiral horns curl close to their heads; their faces and legs are white; they have long Roman noses with large open nostrils; they are heavy in the hind, and light in the fore, quarters, and have little wool on their bellies. The wool is of the clothing quality, and the weight of the fleece is about 3 lbs. on an average. The country consists chiefly of extensive downs covered with short, sweet grass; the flocks kept upon them are very large, and folding on the arable land is extensively practised, for which these hardy sheep are well calculated. They have been crossed of late years with other breeds, particularly the New Leicester, by which a heavier fleece has been obtained; but, on the other hand, the cross is more delicate, and does not thrive on the short down feed to which the old breed was so much attached, and on which it throve so well. The turnip husbandry, and the cultivation of artificial grasses, have, by introducing a more luscious kind of food, changed the character and constitution of the sheep, making them more dainty, so that they do not care to feed on the downs,—fewer sheep, in fact, are kept upon them, which renders the grass coarser and less palatable. Much of the downs, too, were broken up during the high price of corn, and after being exhausted, were again laid down with natural grass, which is necessarily of a very different quality from the old pasture. The ancient breed has, to a great extent, given way to the Southdown, which is found to thrive better, and yield more profit.

12. THE SOUTHDOWN BREED.

The native county of this breed is Sussex, and the district which gives it the name consists of extensive downs similar to those in Wiltshire and Dorsetshire. These tracts of sheep-grazing are covered with a short, sweet kind of grass, the soil being very thin and overlying the chalk, which is within a few inches of the surface. The character of the Southdown sheep is as follows:—Head small and clean; face and legs grey, the latter short and fine in the bone; neck long and fine, rather low before, with a wide shoulder; a light fore quarter; sides and chest deep; a broad loin; back bone rather high; full thigh, and good twist; wool fine, short, and close, the fleece averaging about 3½ lbs. at two years old. The flesh is particularly fine grained, and of an excellent flavour. They fatten readily, and are of hardy constitutions. Fat wethers at two or two and a half years old average about 18 lbs. to 20 lbs. per quarter; and the handsome form of the leg at table enables the butcher to obtain a higher price for it by 1*d.* per pound than for that of any other breed.

About the beginning of the present century, Mr. Ellman, of Glynd, in Sussex, undertook to improve the native Southdown upon the principles laid down, or rather practised, by Bakewell on the Leicesters, and with equal success; his fame introduced him to the late Earl of Leicester, the "Holkham chieftain," at whose annual sheep-shearings Mr. Ellman was almost a constant, and always a welcome, guest. It was found that the improved Southdown sheep were well adapted to the light lands of Norfolk and Suffolk, and they have gradually spread themselves over those counties, and maintained both their character and their standing to the present time. The most successful, as well as early, breeders of the Southdowns in Norfolk were the family of the Overmans, who for sixty years have maintained the purity of the blood, and by careful selection attained the highest pitch of perfection in shape, symmetry, and other excellencies peculiar to the breed. At one of the shows of the Royal Agricultural Society, Mr. Henry Overman, of Weasenham, in Norfolk, sold a pure Southdown ram for 160 guineas. It was purchased, we believe, by a Frenchman.

The tract of land in which this breed of sheep was first located reaches from Beachy Head to Pevensey Marsh, trending westward to Shoreham; its length may be computed at about thirty, and its breadth seven or eight, miles, and containing in its area about 100,000 acres. This is properly the Southdown; but a much greater extent is covered with similar sheep-walk, the downs leaving the coast at Shoreham, and crossing the western part of Sussex and the border, enter Hampshire near Petersfield, between West Harting and Stanstead, having an extreme length of fifty, and a mean breadth of about four and a half or five, miles. These downs rise from 500 to 850 feet above the



THE SOUTHDOWN RAM.

level of the sea, and thus impart to the tract enough of the character of the Highlands, to render the stock fed upon it hardy in constitution. They are everywhere covered with a short, delicate turf, well stored with wild thyme and patches of furze. There are no trees except a few old white-thorns, but young plantations have recently been formed that will, in a few years, afford good shelter to the flocks.

We believe the breed is still kept pure in Sussex, the attempt to cross it with the Leicester not proving successful, the short bite on the downs being not rich enough. The Merino cross was not much more so; nor does it appear that the improved Southdown is capable of, or requires, any amendment by the admixture of any other blood. We confine this observation strictly to the Sussex downs; because in counties where the pasture is richer, or the sheep are grazed on artificial grasses and roots, the Southdown and Leicester, and Leicester and Southdown cross have been entirely successful. In Sussex, Mr. Ellman and his sons have shown what may be done by strict attention to the types of the animals from which they breed.

We have given these gentlemen the first place in the annals of Southdown improvement; but we have perhaps in the present day as remarkable a list of improvers engaged in amicable competition for the prizes at the cattle shows of the country as any nation can produce. Our readers who are conversant with these meetings will anticipate us in mentioning the names of the late and present Dukes of Richmond, Lord Walsingham, and Earl Radnor, the late Sir R. G. Throgmorton, Sir Willoughby Jones, Bart., William Rigden, the Overman family, G. S. Foljambe, Esq., with many other eminent men, who by the most sedulous attention have brought the breed to a pitch of perfection that can only be exceeded by the most fortuitous accident. We can no longer name Jonas Webb in the list, that gentleman having disposed of his splendid flock of Southdowns, and retired, satisfied with the honours and emoluments his efforts had procured. The surpassing beauty of the sheep exhibited belonging to the distinguished persons we have named excites the wonder and admiration of those who see them at the shows.

In Hampshire the Southdown has been crossed with the black-faced race and produced a new type called the Hampshire Downs. They are larger than the Southdown, and are distinguished by a Roman nose, by being longer on the leg, and altogether a stouter and bolder looking animal. Some beautiful sheep of this breed are usually exhibited at the Smithfield Club Cattle Show; but in symmetry and delicacy of form they do not approach the pure Southdowns at their side.

The Oxford and the West Country Downs are also varieties of the Southdown crossed with the native breeds of those districts. The most eminent exhibitors of these cross-bred sheep are the King family in Berkshire; Mr. Walter, M.P., of Wokingham; Mr. W. B. Canning, of Swindon, Wilts, &c.

13. THE OLD NORFOLK BREED.

This is considered an indigenous breed in the counties of Norfolk and Suffolk. They are distinguished by the rams having large spiral horns curling from the head; their legs are long and thin, their loins narrow, neck long, with a high back and thin chine; their bodies are long and thin; their colour varies from black to speckled and white; the legs and face being either black or grey, but mostly black. The wool is fine and short, the fleece of the original breed not averaging more than $2\frac{1}{2}$ lbs., but later improvements have increased it to $3\frac{1}{2}$ lbs., since the beginning of the present century. They are in their roving disposition quite equal to the heath sheep, and being longer in the legs and lighter in the carcase no common fence will stop them, and they have consequently given way to other breeds, as their native commons and heaths have been brought under cultivation. The writer has seen a flock of these sheep clear a fence with as much ease as a greyhound. The rams are sometimes very large and fierce, and are a match for any dog. At seven or eight years old they are nearly as tall as a good sized donkey, and their tremendous horns render them formidable antagonists. The stronghold of this breed is the sandy and open tract of land lying round Newmarket, and from thence to Brandon, Thetford, and Swaffham. Here they had an abundant range of country to traverse, and they throve upon these barren heaths where no other breed could live. The mutton, notwithstanding it was cried down by Culley, was very superior to any other, having the venison flavour, which, although it is nearly half a century since we tasted it, is still fresh in our memory, having never since eaten any mutton equal to it.

The gravy was particularly rich.* Both Marshall and Kent have characterised this breed as the best adapted of any to the soil and system of farming of the older Norfolk farmers, who to a comparatively small extent of arable land added large tracts of heath, over which they ran their sheep during the day, and folded them on the fallows at night. The ease with which they travelled was a great advantage, having sometimes miles to traverse in getting to the fold. The wethers fattened easily at two years old, but never laid on much fat, increasing rather in flesh instead. Loudon considers a haunch of Norfolk mutton after hanging three weeks equal to any meat excepting a haunch of venison.

The Norfolk sheep have frequently been crossed with both the Leicester and the Southdown. The produce of these crosses were polled breeds, and the former were to a certain extent successful, the weight of both the carcase and the fleece being increased; but it was found that while those improvements were secured the cross retained the long legs and the roving disposition of the indigenous parent, and the superiority of the Southdown in every respect, coupled with its quiet and gentle disposition, enabled it to triumph over all its competitors, and the Norfolk sheep is almost, if not quite, extinct.

14. THE HERDWICK BREED.

These are found only in one small district, namely, the mountains standing at the head of the Duddon and Esk rivers in Cumberland. They belong to the hornless race, have speckled faces and legs, short wool weighing from 2 lbs. to 2½ lbs. per fleece, of rather coarse staple for a short-woolled sheep. They are supposed to have their origin in the mountain or black-faced breed, but they have been known by their present name from time immemorial. These hills, as well as the stock, have always been let out to herds, and it is from this that they derive their name. The sheep support themselves during the winter by scratching with their feet through the snow down to whatever herbage may be beneath it, and they are sustained without hay or artificial food of any kind. In storms, says Youatt, they gather together and keep moving about to tread down the snow and prevent it from overblowing them. The lambs are well covered with wool when they are dropped, and seldom take harm from the weather. The ewes breed till fourteen or fifteen years old. The wethers are killed at four or four and a half, when they weigh from 10 lbs. to 12 lbs. a quarter; the ewes from 6 lbs. to 8 lbs. The flesh acquires from the feed a particularly fine flavour, especially when the heather and other mountain plants are in blossom from July to September. These Highlands, which belong to Lord Muncaster, have been chiefly in the hands, as tenants, of one family, the Tysons, 400 years and upwards.

* The writer always fancies that the person who penned the following lines must have had a *leg of Norfolk mutton* in view at the time:—

"Gently stir and blow the fire;
Lay the mutton down to roast;
Dress it quickly, I desire;
In the dripping put a toast,
That I hunger may remove.
Mutton is the meat I love.

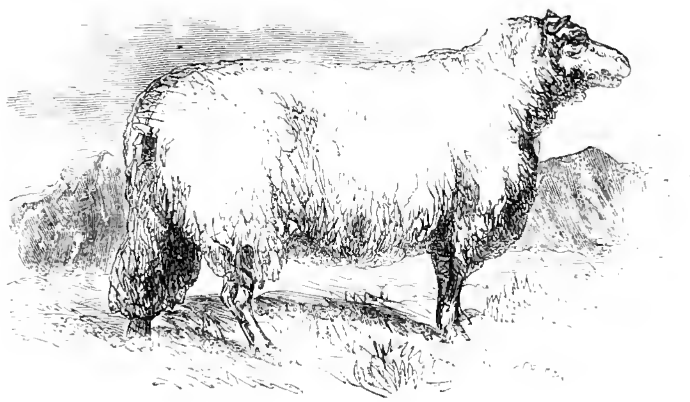
"On the dresser see it lie.
Oh the charming white and red!
Finer meat ne'er met my eye;
On the sweetest grass it fed.
Let the jack go swiftly round;
Let me have it nice and browned.

"On the table lay a cloth;
Let the knives be sharp and clean;
Pickles get, and salads both;
Let them both be fresh and green.
With small-beer, good ale, and wine—
Oh, ye gods, how I shall dine!"

15. THE CHEVIOT BREED.

This breed belongs to the hornless race, and was found originally on the north-west hills of Northumberland, but its adaptation to the Highlands, and its superiority, in many respects, to the black-faced breed, have led to its being extended over the mountainous tracts in the neighbouring counties. It has also to a great extent supplanted the black-faced sheep in the Highlands of Scotland, with the exception of the shires of Perth and Fife.

The Cheviots have generally white faces and legs, but some have black about the nose. They have an open countenance, prominent eyes, are rather long in the body, and have fine small-boned limbs. They have no great depth on the breast or chine. They are generally slaughtered at from three to four and a half years, and their average weight is from 16 lbs. to 22 lbs per quarter. This is the improved breed, the old stock not exceeding from 12 lbs. to 18 lbs. The fleece, too, has increased from $2\frac{1}{2}$ lbs. or $3\frac{1}{2}$ lbs. to



THE CHEVIOT SHEEP.

4 lbs. and $4\frac{1}{2}$ lbs. The wool is inferior to most of the other short-woolled breeds, and is rendered still less saleable by the practice of smearing, or *salving*, them with a mixture of tar, turpentine, and oil, or butter, to fortify them against the rigours of winter. This practice is, however, falling into desuetude. The cross of the Cheviot with the New Leicester has produced a larger sheep at three years old, but they are less hardy, and require better keep. Nevertheless the cross has established itself, and is gaining ground. They have a bare and clean head, rather long ears and jaws, white face and feet; neck full and round, chest open, and a barrel-like form of body. The legs are clothed with wool to the knees and hocks. The wool is of medium length, close, and fine, apt to be curled about the shoulders, and coarse on the hips, tail, and belly. Much improvement upon these points has been made of late years, and the New Cheviot is fast superseding the black-faced race, both in the northern counties of England and in Scotland.

16. THE DUN-FACED BREED.

This is also a mountain breed, having a dun or tawny face, and the wool is streaked variously with black, red, brown, or dun. The texture is fine, and the fleece does not exceed $1\frac{1}{2}$ lbs. at four and a half years old. They are very small in size, and their mutton is finely grained, and of excellent flavour. They are said to have been imported into Scotland from Denmark or Norway at an early period of our history, but it is probable that they have at different times been crossed with other mountain breeds in the north, as there are several varieties, not all imputable to the difference of situation. Culley supposed that this breed originated in a cross of the native sheep with others introduced by the Spanish Armada, part of which was wrecked on the coast of Scotland; and he states a conversation or correspondence he had on the subject with a Mr. Stephenson, of Breakshall, Westmoreland, who said:—"When in Spain, I saw in Andalusia exactly the same kind of sheep you describe under the title of Dun-faced Sheep, and which the Spaniards call *Ovejas Marinas*, of whose wool, I was told, the fine Segovian cloths are made. This wool is reckoned the finest in the world, excepting, perhaps, the Vigonian wool of Peru, and the Cashmerian wools, of which the finest turbans are made." Culley considered the Dun-faced sheep too tender and delicate a breed for the mountains of Scotland, and foretold their being driven out by the black-faced, or, more probably the Cheviot, in consequence of the efforts of the British Wool Society. This, in point of fact, has taken place, and the Dun-faced sheep have nearly disappeared before the latter.

17. THE SHETLAND BREED.

These are a very diminutive animal of the hornless species, distinguished by the shortness and smallness of their tails. They weigh from 7 lbs. to 10 lbs. per quarter. and their fleeces from 1 lb. to 3 lbs. The wool is very fine and varied in colour, but what is remarkable is, that "one of the varieties has coarse wool above, and soft, fine wool below, and has three different successions of wool yearly, two of which resemble long hairs more than wool, and are termed by the common people *fors* and *scudda*. When the wool begins to loosen at the roots, which generally occurs about the month of February, the hairs, or *scudda*, spring up; and when the wool is carefully pulled off, the tough hairs continue fast, until the new wool grows up about a quarter of an inch long, when they gradually wear off; and when the new fleece has acquired about two months' growth, the rough hairs, termed *fors*, spring up, and keep root until the proper season arrives for pulling it, when it is plucked off along with the wool, and is separated from it in dressing the fleece by an operation called *forfing*. The *scudda* remains upon the skin of the animal as if it were a thick coat, a fence against the inclemency of the season which provident nature has furnished for supplying the wants of the fleece."*

Another native breed has what is termed soft cottony fleeces, the wool of which is short, and open, and has no long hairs. These sheep frequently have their fleeces rubbed off during the spring; and they are never shorn, the wool being pulled up by the roots, whether ripe or not, "a barbarous practice," says Culley, "tending to weaken the sheep, and hurt the length of the staple. The colour of the wool varies from white to black, and includes silver-grey (the finest and softest) and *mourat*, or brown. The white is considered the most valuable for all the finer purposes in which combing wool can be used. For softness and lustre no wool equals it, and the skin with the fleece on can be converted into a fur of very great value." †

* Culley on "Live Stock," p. 162. † Ibid., p. 164.

The Shetland sheep are very hardy and wild, and very little care is taken of, or attention paid to, them. The Shetland Islands contain in all about 80,000 of them; and in winter they have no other subsistence, when a deep snow covers the ground, than the sea-weed thrown upon the shores. The wool of these animals is as shaggy as the coat of a Welsh goat. *Mainland*, which is the largest of the Shetland Isles, contains a great number of them, and their wool is chiefly made into very fine stockings, at knitting of which the female inhabitants are very expert. The sheep feed in the interior of the island, but instinctively run down to the coast, although several miles from it, as soon as the tide begins to fall, to feed on the fresh sea-weed.

18. THE SPANISH OR MERINO BREED.

The Spanish term *Mesta* signifies a mixture of two or more kinds of grain, but is applied in a more restricted sense to the union of the flocks of sheep belonging to several different proprietors into one collected body, which travel backwards and forwards twice in the year, passing part of it at one place and part at another. This collection is formed by an association of proprietors consisting of nobles, persons in power, members of rich monasteries, and ecclesiastical chapters, who feed their flocks on the waste lands of Spain. The possession of these lands by the present claimants dates back to the time of the great plague, which swept off the major part of the landowners. The soil was then taken possession of by the remaining families and others, by whom, although they hold no legal title, they are still retained. The extent of these lands being too great to be cultivated by the limited resources of the scattered population, the only way of appropriating them profitably was by keeping flocks. These are called *Merinos* or *Transhumantes*.

The extensive feeding grounds on which the flocks are pastured during the winter lie in Estramadura, the kingdom of Leon, and other provinces. The *Mesta* generally consists of 10,000 sheep each. They are under the care of an officer called a *mayoral*, who superintends the shepherds, and directs their routes. Of these he has fifty under him, divided into four classes. They commence their journey in April or May, and return in October. The principal districts occupied by these flocks are Cuenza in New Castile, and Segovia, Soria, and Buytrago in Old Castile. In September they commence their journey back, and in winter occupy the same pastures in Estramadura and Leon on which they were fed the previous winter. The term *Merino* is strictly a Spanish adjective, derived from the Latin word *merinus* or *majorinus*. When united to *ovejas* it signifies the royal judge or superintendent of the sheep-walks. The number of sheep formerly kept in Spain was estimated at 8,000,000, employing 40,000 shepherds. We have no means of ascertaining correctly the number in the present day, but probably they have not increased since the revolution in that country changed the proprietorship of much of the land.

The establishment of the fine-woolled breed of sheep of Spain is distinctly traced back to the time of Columella, the Roman agriculturist, who lived in the reign of Claudius. His uncle lived in Spain, and introduced a cross of the coarse-woolled African sheep with the Tarentine breed, and by judicious management brought the mixed breed to a high state of perfection. They kept their sheep covered to improve the quality of the wool, but paid little regard to that of the mutton.

The jealousy of the Spanish government prevented for many centuries the exportation of the Merino sheep, but in the year 1723 some of them were obtained by a M. Alstroemer, and taken to Sweden, where they were soon acclimated and throve greatly, so that in 1764 they had increased to 65,369 pure Merinos, and 23,384 of a mixed breed, but producing fine wool. The Swedish Merino preserved the quality of the wool, at the same time that the carcase was larger, and the constitution of the animal much stronger than that of the native Spanish.

The success of the Swedish experiment induced the Saxony government to obtain some of the Merinos; and in 1765, 100 rams and 200 ewes were purchased out of the best flocks in Spain; and in 1778 a further importation was made into Saxony, the success of which is well known from the large quantity of fine wool that was for many years imported from thence into Great Britain. Afterwards Denmark, Prussia, Austria, France, Holland, Italy, and the Cape of Good Hope successively obtained the Spanish sheep, and in every instance in which proper attention was paid to them they have prospered.

In 1787 George III. obtained a few Merinos, the jealousy of the Spanish government being at that time awakened; but six years after Lord Auckland, then our ambassador at Madrid, obtained five rams and thirty-five ewes of the very best breed (the *Negrette*) in exchange for a stud of eight fine English coach-horses. These were added to his Majesty's previous flock, and, amounting to sixty, were placed under the charge of Sir Joseph Banks, who had for many years paid great attention to sheep-breeding and the improvement of the quality of wool. In 1804 his Majesty consented to part with a portion of the flock by public auction, and forty-five rams and ewes were offered, the competition for which was very great, so that they fetched prices ranging from £6 7*s.* to £44 2*s.* each, being distributed among eighteen purchasers.* But the most important feature in this sale was the purchase by Captain McArthur of eight of the sheep for the purpose of transporting them to the penal settlement of New South Wales, or Botany Bay, as it was then called, to which we shall have occasion again to refer presently.

With respect to the Merinos purchased by English breeders, the experiment did not succeed. Notwithstanding the disinterested efforts of the king, and the strenuous co-operation of Lord Somerville, the President of the Board of Agriculture, the competition between the Merino breed and those of the New Leicester and improved Southdown, ended in favour of the two latter, both on account of the weight of the fleece, and that of the carcase. This sealed the fate of the experiment in Great Britain, so far as the agricultural body were concerned, although individual amateurs continued, and do still continue, we believe, to encourage the breed. The only person, however, who exhibits at the show of the Royal Agricultural Society is Charles Sturgeon, Esq., Ockendon Hall, Essex, who, we understand, has a flock of Merinos, and has for some years been an exhibitor at those shows.

It is not, however, at all likely that the Merinos will ever be established in England

* An amusing circumstance occurred just about this time in reference to these sheep. The king invited Mr. Coke to go to Windsor and see them; and when examining them he exclaimed, in his usual impetuous way, "Coke, Coke, you must have some of these sheep. I'll look out a ram and some ewes, and send them to you." Of course Mr. Coke, supposing that they were intended as a present, was profuse in his thanks to his Majesty for his kindness. The sheep were accordingly sent, and with them an account in which they were charged at a price that *astonished even* the purchaser, accustomed as he was to high-priced cattle. These sheep were exhibited at Holkham when the writer was present, and he was not surprised to see the farmers turn from them with disgust, declaring they were "nothing better than carrion!"

on commercial grounds, more especially now that we can obtain an ample supply of the very best wool from our Australian colonies. The large consumption of meat, and the consequent high price, form the main features in the question, it being impossible to raise the value of the carcase of the Merino to anything like that of the New Leicester or Southdown; and, on the other hand, the prices of the short and long wools so nearly approximate to each other, owing to the great demand for, and limited supply of, the latter on the continent, that the *weight*, and not the *quality* of the wool, now determines the value of the fleece.

The history of the rise and progress of sheep-breeding in Australia forms one of the most remarkable episodes in the annals of that colony; and as it has a material influence on the agriculture of the mother country, it demands a special notice. In 1788 some coarse-woolled sheep were purchased in the East Indies (Bengal) for Captain McArthur, who was at that time settled in New South Wales. Nine years afterwards (1797), Captain Kent, R.N., was requested by the Dutch government to convey three rams and five ewes of the pure Merino breed to the Cape of Good Hope, then a Dutch colony. On arrival, the settlers would have nothing to do with them, and Kent was obliged to take them on to New South Wales, which was his ultimate destination. On their arrival Captain McArthur gladly purchased them to cross with his coarse-woolled Bengal sheep; and in ten years his flock of seventy of the latter had been replaced by 4,000 half-bred breeding ewes and a proportionate number of rams, the wethers being slaughtered.

In 1803 Captain McArthur revisited England, and, as we have stated, purchased some of his Majesty's flock of Merinos. But some demur took place with the Customs, owing to an ancient statute making it felony to export live sheep from Great Britain. In this case, however, common sense prevailed over red tape and fiscal absurdity, and the sheep were, with assumed connivance, put on board the *Argus*, and became the founders of one of the most important branches of commerce between the colonies and the mother country. To show the extraordinary progress of sheep-breeding in those colonies, we give the amounts of the wool exports at intervals of ten years. The first importation from New South Wales was made in the year 1808.

1808	562	lbs.
1818	86,525	„
1828	834,343	„
1838	5,749,376	„
1848	22,991,481	„
1858	51,104,560	„

The Australian supply of wool has now superseded, to a very great extent, that which we once obtained from Spain and Germany; and a considerable quantity is also purchased at the periodical sales, for exportation to France and other continental countries. It is found to be superior, both in the length of the staple, and in fineness of the fibre, which possesses a peculiar softness not found in the same degree in the wools of any European country.

Such is the history of the Merino sheep in connection with the United Kingdom; and the agriculturists have no reason either to regret their rejection of it, or to attempt ever to bring it again into competition with those excellent indigenous breeds which they have, at so much cost of labour and money, raised to the highest pitch of perfection.

19. THE MERINO CROSS-BREED.

The experiments that have been made in crossing the Merino sheep with the Southdown and the improved Leicester, while they produced a finer fleece in regard to the staple, detracted too much from the weight to make the improvement profitable. On the other hand, the deteriorated carcase of the product was, in a country where the value of mutton is the most important consideration in choosing a breed, quite sufficient to condemn it. We are not aware that any considerable flock-master has adopted the Merino Cross on commercial grounds, although some of the more enterprising amateur breeders may have experimented upon it; but this cannot be considered as constituting a distinct or permanent variety.

SECTION XXVII.

THE PIG.

The pig, or hog, is the *Suidæ*, or *Sus*, of the ancients, and the same terms are adopted by Linnæus. Cuvier classes it with the mammalia, and places it in the order *Pachydermata*, and genus *Suidæ*, or *Sus*. "It has on each foot two large toes shod with stout hoofs, and two lateral toes much shorter, and scarcely touching the earth. The *incisors*, or cutting teeth, are variable in number, the lower ones being all pointing forwards; the canine teeth project from the mouth, and are curved upwards. The snout, which terminates the muzzle, is fitted for rooting and grubbing in the earth, being invested with a strongly callous and flexible muscle, with which it can turn up earth and stones, as well as the roots of plants, and even trees. There is but little division in the stomach, and the body is square and deep, covered with hair and bristle, more or less, according to the breed. The neck is strong and muscular, the legs (of the improved breeds) short and stout." Such is Cuvier's description of the animal, which feeds chiefly on vegetable food, especially roots, which it raises from the earth with its snout; but it will devour animal food of any kind, although it will not hunt for living prey for that purpose. The skin of the hog is very thick, being useful for making saddles. Its most active faculties are those of seeing, hearing, and smelling. Throw, for instance, a quantity of peas amongst the straw in the barn-yard, and it must be a chance indeed if one escapes the search of a pig.

Naturalists place in the same order with the pig, the elephant, the rhinoceros, the hippopotamus, the peccara, the babyroussa, the phaco-choare, the capibara, &c.; but the genus *Suidæ*, or *Sus*, is now very generally applied to the swine alone, properly so called, whether in a domesticated or a wild state.

Although no mention is made of the hog, or swine, in the sacred writings previous to the time of Moses, when its use as an article of food was strictly prohibited by the Divine command, yet the very prohibition itself was a proof that previously it had constituted a considerable portion of the food of the people; and the records of profane history serve to confirm this fact, for the writings of the most ancient of the Greek authors refer to it as a species of food in much esteem. Amongst the Romans the breeding, rearing, fattening, and cooking of the pig constituted a study, or studies, and every art was used to improve the flavour of the flesh. It was sometimes fed on dried figs and sweet wine. The *Porcus Trojanus* is an example of the extravagant manner in which the *gourmands* of that period pampered their appetites. It consisted of a whole hog, divested of its natural inside, and then stuffed with thrushes, larks, beccaficoes, oysters, nightingales, and other kinds of delicacies, and basted, while roasting, with wine and rich gravies. A sumptuary law was passed to check such extravagance in eating, but it had little effect. The most barbarous means were invented to produce a supposititious improvement in the flavour. Thus the barbecued hog was first whipped to death, in order to save the finer portions of the natural juices which were wasted by cutting its throat.

The Jews were not the only nation which abstained from eating swine's flesh. The Egyptians and the Mohammedans did so, the latter probably founding their practice on that of the Israelites. The Egyptians were only allowed to eat pork once a year, when a feast of the moon was held, and a large number of hogs were sacrificed to that divinity. If at any other time an Egyptian touched a pig, he was obliged to purify himself by plunging, with his clothes on, in the Nile. The swineherds were considered outcasts of society, and were not allowed to enter a temple, or even to marry into other families. This, also, appears to have been the case with the Jews, as is exemplified in the parable of the prodigal son, who, being reduced to the necessity of feeding swine, was considered to have sunk to the lowest state of degradation in society. No really satisfactory solution of a moral kind has been yet given for the prohibition in the Mosaic law; and it is probable that the reasons were chiefly of a sanitary nature, the food being particularly luscious and unwholesome in a warm climate. But whatever they may have been, it is certain that under the Christian dispensation we are not enjoined to call any kind of food "common or unclean,"* but to receive with thankfulness those things which nature supplies, and which are adapted to the sustentation of life and health.

The Egyptians rear no pigs, and in Lower Egypt that animal is scarcely known. The Mohammedans are enjoined not to eat a certain part of the pig; but the part not being named in the prohibitory law, the more strict followers of the prophet abjure the whole; whilst the less scrupulous abstain from whatever part they consider the least to their taste, and

> "Thus, conscience freed from every clog,
> Mohammedans eat up the hog."

Notwithstanding the Divine command, it is well known that the Jews reared great numbers of swine in their country of Judea, it is supposed for the purpose of supplying the Gentiles of the neighbouring districts, and other strangers. The remarkable narrative respecting the herd of swine which by the command of the Saviour were possessed with demons, and under their influence ran down a steep place and perished in the sea,† is considered to have been done in order to punish the Jewish owners of the herd for their disregard of the Divine prohibition.

* Acts xi. 9.

† St. Matthew viii. 32.

In the present day, the pig, although in some respects a disagreeable and disgusting creature, holds no contemptible place amongst our domestic animals. On the contrary the breeding, rearing, and fattening of swine are as sedulously attended to as in the case of any other animal; and they are probably the most profitable of any, on account of their fecundity, and the little cost attending them in the earlier stages of their existence. The pig will eat any garbage, and will subsist and thrive where a sheep would absolutely starve. "The refuse of the fields, the gardens, the barns, and the scullery is to him a feast."* He adapts himself to all countries and climates, has apparently but little choice of food, provided he has *enough*, and is clamorous about it only under "short-commons."

SECTION XXVIII.

THE BRITISH HOG.

If there is any faith to be placed on the legendary history of the city of Bath, the hog has been a domesticated animal in Britain upwards of 2,700 years; and it was to a herd of them kept by a British prince that we owe the discovery of the medicinal properties of the hot springs of Bath. It appears that Bladud, or Baldred, the eldest son of Hudibras, King of Britain, had contracted the leprosy at Athens, whither he had been sent to study for eleven years; consequently, when he returned home he was confined apart from his family to prevent the spreading of the disorder. Escaping from his confinement, he wandered to Learwick, a small village about three miles from Bath, where he became a swineherd, driving his charge from place to place, that they might feed on the acorns, beech-mast, &c., of the woods. One morning the herd scampered down the side of the hill till they reached a place where the hot springs of Bath are now situated, and after wallowing in the moory bed, returned covered with black mud. Bladud, who had acquired habits of reflection among the *savans* of Athens, was surprised that the pigs should seek a bath in winter time, as well as in summer, and set about studying the facts of the case. On examining the spot he found that a steam arose, and further investigation showed him that the mud was warm. Moreover the pigs by repeated ablutions in these mud baths, became quite free from the cutaneous disorders with which they were previously afflicted; and the prince, judging by analogy, tried the effect upon himself, and to his great joy was completely cleansed from his leprosy. He then told his employer who he was, and the latter being satisfied of the truth of his story, took him to the court, where he was gladly received. Upon his father's death he erected the first baths. In one of those subsequently built on the spot is a statue of King Bladud or Baldred, placed there in 1699 with the following inscription:—"Baldred, son of Lord Hudibras, eighth king of the Britons from Brute, a great philosopher and mathematician, bred at Athens, and recorded the first discoverer and founder of these

* Culley, p. 172.

baths, 863 years before Christ." Let no man go to Bath and question the truth of this legend in presence of a native, if he values a whole skin or a sound cranium

Be this, however, as it may, we have sufficient evidence, independent of this legend, of the pig forming a conspicuous part of the live stock of our Saxon as well as British ancestors. Cæsar mentions that the flesh of this animal furnished the natives of Britain with a variety of dishes; and swine are continually referred to in ancient records, grants, wills, and exchanges of property. The forests then covered a large portion of the country, and in these the swine found abundance of food. They constituted a considerable portion of the agricultural wealth of the landed proprietors, and were made the subject of legacies. Thus Alfred, a nobleman, left a relative a hide of land and 100 swine; another 100 for masses for the good of his soul, and 2,000 to his daughters. In the original of Doomsday Book for Hampshire, in which an estimate is given of the value of the king's land and forests, the number of hogs that can be fed on each separate part is invariably specified.

In Wales the laws of Howel treat of the value of swine. "The price of a pig from the time it is born until it grows to burrow is one penny; when it ceases suckling at the end of three months, it is worth two pence. From that time it goes to the wood, and is considered a swine, and its value is worth four pence. From the Feast of St. John unto the 1st January, its value is fifteen pence; from the 1st January unto the Feast of St. John, its value is twenty-four pence; and from that time forward its value shall be thirty pence, the same as its mother. The qualities of a sow are, that she breeds pigs, and do not devour them. The seller must also warrant her sound against the quinsy for three days and nights after she is sold. If she should not possess these qualities one-third of her price must be returned. The value of the boar is equal to the value of three sows."*

Nor were swine of less account, or less under the control of the legislature in England in the early periods of history. The midland counties were then nearly covered with forests of beech and oak, which, in the autumn and early winter, supplied abundance of food for these animals; and sometimes they were allowed the run of the woods the whole year. Gilpin, in his "Forest Scenery," describes the method employed to reduce a herd of swine to order when taken to the woods, in the following terms:—"The first step the swineherd takes is to seek out some close, sheltered part of the forest, where there is a conveniency of water, and plenty of oak or beech-mast, the former of which he prefers, when he can have it in abundance. He next fixes on some spreading tree, round the bole of which he wattles a slight circular fence of the dimensions he wants; and covering it roughly with boughs and sods, he fills it plentifully with straw or fern.

"Having made this preparation, he collects his colony among the farmers, and will get together perhaps a herd of 500 or 600 hogs. Having driven them to their destined habitation, he gives them a plentiful supper of acorns or beech-mast, which he had already provided, sounding his horn during the repast. He then turns them into the litter, where, after a long journey and a hearty meal, they sleep soundly.

"On the next morning he suffers them to look around, shows them the pool or stream where they may occasionally drink, leaves them to gather the offal of the last night's meal, gives them another plentiful repast under the neighbouring trees, that

* "History of the Anglo-Saxons," by Sharon Turner. Vol. iv.

almost rain acorns upon them, for a considerable time to the sound of the horn, and then sends them once more to sleep.

"On the following day he is perhaps at the pains of procuring them another meal, with music playing as before. He then leaves them a little more to themselves, keeping his eye, however, upon them about evening. When their bellies are full they seldom wander far from home, but commonly retire orderly and early to bed. After this he throws the stye open, and leaves them to cater for themselves; and henceforward has little more trouble with them during the whole time of their migration, but returns home regularly every evening, though they sometimes stray two or three miles from their stye. . . . . By this management the herd is carried home to its owners in such a condition, that a little dry meat will soon fatten them.

"Besides the hogs thus led out in the mast season to fatten, there are others the property of forest keepers, who spend the whole year in similar societies. After the mast season is over, the indigenous forest hog depends chiefly for his livelihood on the roots of fern, and he would find this food very nourishing if he could have it in abundance. But he is obliged to procure it by so laborious an operation, that his meals are rarely accompanied by satiety. He continues, however, by great industry, to obtain a tolerable subsistence through the winter, except in frosty weather, and he must then perish, if he does not in some degree experience his master's care."

It may be supposed that this system would sometimes lead to the loss of hogs in the woods; and these would become wild, and be taken by hunting them with hounds, as is practised on the Continent to this day. In the fastnesses of these forests the wild hog was secure from intrusion, except at intervals; and it was no child's play to encounter a boar of this wild breed. Hertfordshire, Buckinghamshire, and Hampshire were almost all forest; and so lately as 1646, the forest of Norwood in Surrey, only four or five miles from London, contained 830 acres, on which the inhabitants of Croydon had liberty of grazing their cattle of all kinds, and as many swine as they could muster. All the forests were crown property, but the borderers had an inalienable right to fatten swine in them upon paying a small tax or fine. The practice is still in full force in Germany, where most of the villages have their swineherd, who, at break of day, goes from house to house collecting his noisy troop, blowing his still more noisy cow-horn, and cracking his clumsy whip, until the place echoes with the din.

It is generally supposed that the domesticated hog derived his origin from the wild boar, with which the forests of Britain abounded previous to, and for some centuries after, the Conquest. The woodlands north of London contained wild boars, stags, fallow deer, and bulls in the time of Henry II.; and Whittaker states that the wild boar roved at liberty over the woods of the parish of Manchester for many centuries after the Romans had left that station, and that hence the name of Barlow (*boar ground*) came to be assigned to a district in the south-western portion. Many other places in the kingdom bear names from their being formerly the haunts of these beasts. No record remains to indicate the period when they became extinct, but in the fourteenth century laws were enacted for the preservation of beasts of venery, amongst which both the wild boar and the wolf were named. Charles I. attempted to reintroduce them by procuring males and females of the breed from Germany, which were turned adrift in the New Forest, in Hampshire; and there is still, or at least was, a few years since, a breed of "forest pigs," essentially different from the true Hampshire, and with more of the characteristics of the wild boar. Certain it is that all the ferocious animals have given way before the advance of civilisation, and the extension of agriculture, which are totally incompatible with their existence.

There are many reasons leading to the opinion that the English breed of hogs is derived from the wild breed. Not only did they exhibit a great similarity in their form and habits, but where the wild boar has been tamed, he was found to copulate with the domesticated animal of all breeds, and the period of gestation is the same in both the wild and the tame sow. There is still a breed of pigs in Ireland (although now nearly extinct) possessing many of the traits of the wild breed. The writer purchased one of these in a lot of others. It was long and bony in the legs, light as a greyhound in the carcase, had a long head, and large flapping ears. After keeping it for six months on abundance of nourishing food, it had scarcely made 1 lb. of fat, and he sold it, in utter despair of ever making it fit for the knife. This was formerly the principal breed of England, but is now very seldom to be met with. The chief recommendation it possessed was its prolificness, and the care it took of its offspring. In other respects it was not profitable, being, like our Irish friend, a heavy feeder, without a corresponding increase in size, or accumulation of fat. Youatt seems to think that it would have been well to have retained the breed with improvement, rather than to discard it altogether for the smaller breeds. Be this as it may, the latter have now obtained the ascendancy, and they certainly yield more profit to the farmer than the old breed. We strongly suspect that Youatt never saw, or, at any rate, never possessed, any of these "light cavalry" of the sty, or he would have been slow to give them credit for any excellence to counterbalance their glaring imperfections and shortcomings. As to the supply of pork, which he thought was in danger of falling short in consequence of the prevalence of the smaller breeds, there is no fear of such a result. The farmers are too much alive to the question of demand and supply not to be aware *by the price* of pork, when the first is greater than the last, and that it is to their interest to increase the supply, and thus restore the balance.

The large breed of pigs prevailed in most of the English counties, exhibiting various differences, like other live stock, according to the local circumstances to which they were subjected. The Old Yorkshire, for instance, was one of the largest varieties, having long legs, flat sides, narrow backs, weak loins, and large bones. Their colour was a dirty white, spotted with black; hair short and wiry, mixed with bristles about the head and neck, and long ears. With all their advantages of size they seldom exceeded 30 st. in weight, and required an undue proportion of food to reach that. In Leicestershire, Shropshire, Gloucestershire, Herefordshire, &c., different types of the same breed formerly prevailed; and that in Cheshire was the largest of all English hogs. They stood from three and a half to four and a half feet high, were long bodied, narrow backed, slab sided, large boned, and long limbed. Their heads were large, and their broad, pendant ears hung over their eyes, and their skins were loose and coarse. They fattened up to an enormous weight, without requiring a greater proportion of food than a smaller breed. This pig has produced an excellent cross with the Berkshire boar, which, with other crosses, has almost exterminated the old breed. The Chinese cross has greatly improved the fattening qualities; and while it has reduced the size, has, at the same time, produced a more early maturity.

The present breeds or varieties of pigs are as numerous almost as the fancy breeders, and many of them take the names of the particular parishes, or even the farms on which they were first reared. The most generally acknowledged at the various cattle shows may be reduced to the following list:—

1. The Berkshire.	6. The Black Suffolk.
2. The Hampshire.	7. The Essex.
3. The Sussex and Kent.	8. The Lincolnshire.
4. The Windsor.	9. The Chinese.
5. The White Suffolk.	10. The Irish.

1. THE BERKSHIRE BREED.

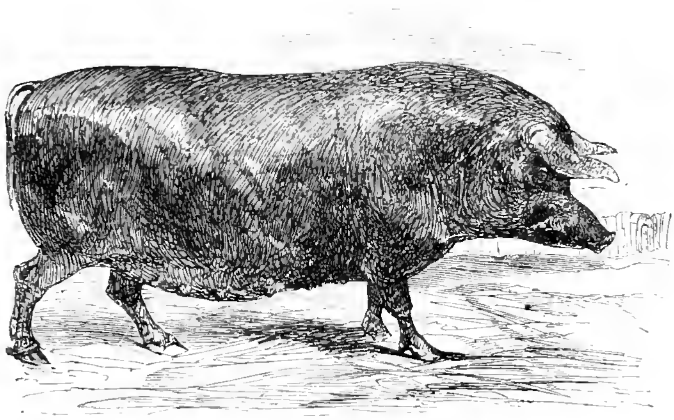
This is a large and very profitable breed of pigs, and is in general estimation on that account. Their colour is a reddish brown, spotted with black, or very dark brown, and they are destitute of bristles. The hair of their bodies is rough, and a fringe of long hairs borders their ears. Their bodies are stout and compactly formed, their legs short, sides deep, heads firmly set on, snouts short, cheeks full, ears erect, flesh firm and finely flavoured, and skin thin. The bacon of the Berkshire hog is greatly esteemed. The smallness of the bone of this breed is a powerful recommendation of it; and it is considered one of the best in England, being also an early and apt fattener on a small proportion of food, and a prolific breeder. It has now a very extensive range throughout almost the whole kingdom, and some excellent crosses have been tried with other breeds; but none are superior to the original, some of which have been known to fatten up to 120 st., of 8 lbs to the stone. Culley mentions one that was fed by Mr. Lawton, of Cheshire, which measured from the snout to the end of the tail three yards eight inches in length, was four feet five and a half inches in height, and when killed and dressed weighed 151 st. 7 lbs. (8 lbs. to the stone), or 86 st. 11 lbs. avoirdupois. The ordinary weight, however, is from twelve to fifteen score, and, at two years old, they sometimes reach twenty score. The most approved cross of the Berkshire pig is that with the Suffolk and Norfolk boar, the produce of which is a smaller, but very hardy, kind of animal that fattens readily; but in general the pure Berkshire is the most approved.

A particularly fine breed of Berkshire pigs has been reared at Coleshill, in that county, by Lord Radnor. They are white, with strong hair, very small bone in proportion to their size, small head, square and compact form, large frame. They have successfully competed at the cattle shows, and are much esteemed by the breeders. The improved Berkshire are mostly either wholly white or black, and fatten with much greater facility than the original breed, and at a much earlier stage of life. Mr. Druce, of Ensham, has a black breed, which derives its origin from a cross of the Berkshire with the Neapolitan pig, whilst the Coleshill breed is the produce of a Berkshire sow with a Chinese boar. Both breeds are excellent in their kind.

2. THE HAMPSHIRE BREED.

There are two varieties of pigs in Hampshire, a large and a small, and both have of late been subjected to crossings with the Berkshire, the improved Suffolk, and the Essex. The original large breed was white, or black and white, and had a long neck, flat sides, and large bones, all indicative of its affinity to the old English breed we have described. They required a great quantity of food to fatten them, but when well fed, frequently reached from 40 to 60 imperial stones. The small variety was obtained by crossing, and is more readily and earlier fattened. They frequently attain a considerable weight, and their bacon is much esteemed for its excellent flavour.

In the New Forest is a wild breed called the "forest pig," to which we have already referred, as having been imported from Germany by the command of Charles I., and turned adrift with the view of re-establishing the breed of wild boars in England—a retrogression in the march of civilisation quite characteristic of the Stuart family. The idea of restoring the practice of boar hunting was more regarded than the safety and well-being of the people, who, in the neighbourhood of the Forest, have been subject both in persons and property to the attacks and depredations of those ferocious and destructive brutes. The "forest pig" is described by Youatt as broad shouldered and high crested, light and lean in the hind quarters, with a bristly mane, and erect ears.



THE IMPROVED HAMPSHIRE HOG.

His colour was dark or blackish, and he lived chiefly on beech-mast and acorns. In their semi-wild state they are fierce and savage, do not readily fatten, nor are they at all profitable to the butcher, or those who kill them. Gilpin, in his "Forest Scenery," gives the following graphic account of his encounter with a herd of these forest swine. He had thrown himself on the greensward to rest and shelter under the dense foliage of a large beech tree, when, "suddenly a sound like that of warlike music, mellowed by distance, came upon our ears. We started so far up from our recumbent position, as to lean upon one arm and listen intently, and not without some degree of awe, being almost persuaded that some wondrous fairy pageant was about to gratify our sight.

"The sound increased and grew harsher as it advanced, and as it drew yet nearer, the tramp of what might easily have been imagined to be elfin chivalry accompanied it. At length, while we yet listened in mute expectation, the leading boar of a large herd of forest pigs came grunting into view, followed by all the musical members of his harmonious detachment.

"Whether it was the cheering, invigorating effects of the sunshine, or whether there was something particularly savoury in the herbage of that spot we know not; but the grunting swelled into a loud chorus, their snouts became more and more busy, their ears and tails kept up one continuous and joyous motion, and their small eyes seemed to flash back the sun's rays with unwonted eagerness of expression. It was really an interesting sight; and were it not that swine were the subject of it, we should, and truly, say it was as beautiful as interesting. The creatures were in fine condition; their bristles glittered like silver; their bodies were as clean as if they were as regularly washed and combed as a lady's lap-dog; and they seemed so full of freedom and happiness, that while looking on them we felt all the romance of forest life, and recollections of the 'merrie green wood.'

"Wishing to observe and admire them more closely, we sprang up, but in so doing alarmed them, and off they galloped helter-skelter, '*sauve qui peut*,' with a speed that none of the porcine race not 'forest-born' and bred could equal; and long after every one was out of sight—vanished in the mazes of the woodland—we still heard their retreating trumpets gradually dying away until lost in the distance."

3. THE SUSSEX AND KENTISH BREEDS.

There is but little difference between the native breeds of these two counties, which in some respects are similar to the large Old Berkshire, and in others to the black and white Essex pig. The Old Kentish pigs are long in the legs, and narrow backed, ears moderately long, hair white and thickly set. They are moderately sized, and when full grown and fat will weigh from 18 st. to 25 st. of 14 lbs. The Rudgwick breed, however, which takes its name from the village of that name in Sussex, is considered the largest breed of swine in England, fattening at two years old to 60 or 70 imperial stones. They are valuable as bacon hogs, but as they are comparatively large consumers they are not much in favour, and are now seldom met with.

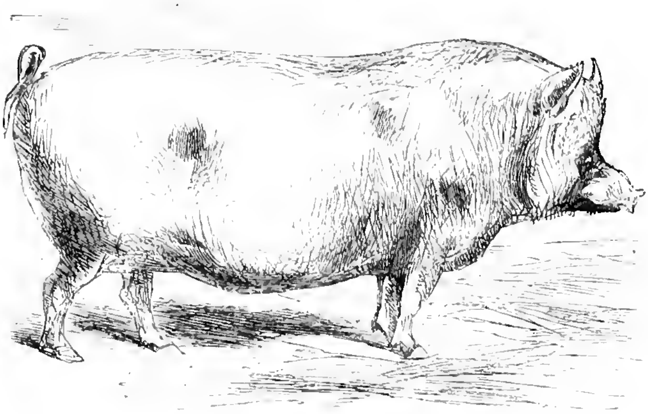
The Old Sussex is a rather small black and white breed, handsomely formed, hair thinly set, fine, and long; ears pointed forward, long thin face, with a small mouth, &c. These pigs mature early and fatten freely. Their flesh is of excellent quality when they are well fed and full grown. Their average weight is 18 or 20 imperial stones. A cross with the Lincolnshire pig has increased their size, but not improved them in other respects.

4. THE WINDSOR BREED.

We are indebted for this breed to the late Prince Consort, who paid great attention to this class of animals, as well as to cattle. The Windsor pigs are of a small size, but remarkable for their tendency to accumulate fat at a very early stage of their growth. They are white, and are noted for the smallness of their bone, and the delicate shape of their heads and pointed ears. His Royal Highness received several prizes and medals for these pigs, but we have no means of knowing what particular breed they originated from, except their shape, make, &c., by which we should judge they are a cross of the native Berkshire with the improved Suffolk and Chinese.

5. THE WHITE SUFFOLK BREED.

The present breed of White Suffolk pigs is a cross with the old race and the improved Berkshire. The old native pig was white, with long legs and body, and narrow back, a broad forehead, close short hair, very bristly. This animal was first improved by a cross with the Lincoln, which produced a more hardy animal, that fattened more kindly up to from 30 st. to 40 st. imperial weight. One breeder, Mr. Thomas Crisp, of Butley Abbey, near Woodbridge, has been remarkably successful in his efforts to improve the Suffolk breed; and his stock is in so much request that the produce of one sow has paid him not less than £1,000. These pigs are short legged,



THE IMPROVED SUFFOLK HOG.

small boned, compact, well formed, and hardy, and will fatten at twelve or fifteen months old up to 15 or 16 score if well fed. The Norfolk pigs are much the same as the general run of Suffolk; the Chinese strain is perceptible in most of them, that animal having been introduced into Norfolk about seventy years ago by the late John Culley, Esq., then of Ringland, near Norwich, who had a large stock of them, which were thence disseminated over the counties of Norfolk and Suffolk, and have greatly promoted the improvement of the various breeds that previously existed.

6. THE BLACK SUFFOLK BREED.

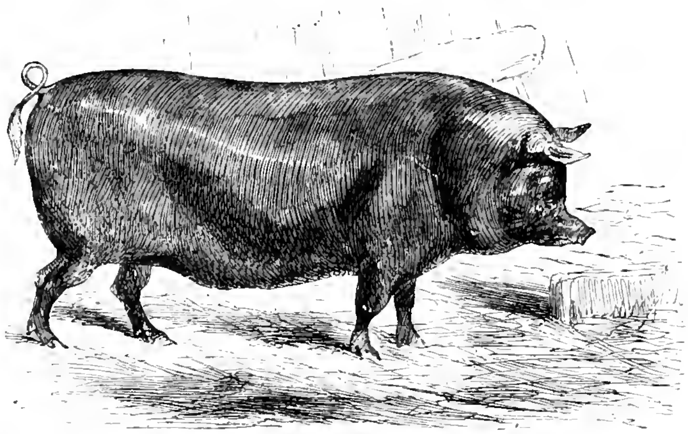
This breed is, we believe, the produce of a cross of the Black Berkshire with the improved Suffolk. In other respects they are similar to the white—for instance, in their disposition to accumulate fat. The Neapolitan breed has also been introduced by some of the breeders, and has greatly improved the shape and symmetry of the native stock. Mr. Crisp's improved Black Suffolks are a remarkably fine breed, and have gained him many prizes at the shows of the Smithfield Club.

7. THE ESSEX BREED.

These are derived from a cross between the Berkshire pig and the Neapolitan. They are mostly black and white, but sometimes wholly black. Some have the head and hind part black, and the back and belly white. Their heads are smaller than those of the Berkshire swine, with long, thin, upright ears, short hair, a thin skin, full hind quarters, and a deep barrel-shaped carcase, small bone, and delicate well-flavoured flesh. Lord Western took great pains to improve the Essex breed, and his stock is now disseminated throughout that county; but it is a little remarkable that not one professedly Essex pig was exhibited at the Smithfield Club Cattle Show in December, 1861.

Mr. Clare, of Hindley House, near Liverpool, has raised a valuable breed of Essex pigs, one of which has won him eight first prizes, two second, and one third, at various shows. Several litters of this sow have brought her owner £120.

The black breed is the most esteemed, and is distinguished by small excrescences hanging from the throat termed "wattles." They are not quick fatteners, but will



THE ESSEX PIG.

reach 35 imperial stones when well fed. They grow rapidly, laying on flesh rather than fat; and their pork, whether eaten fresh or as bacon, is fine flavoured and not too much loaded with fat. The breeding sows are not reckoned good nurses, but they have large litters.

8. THE LINCOLNSHIRE BREED.

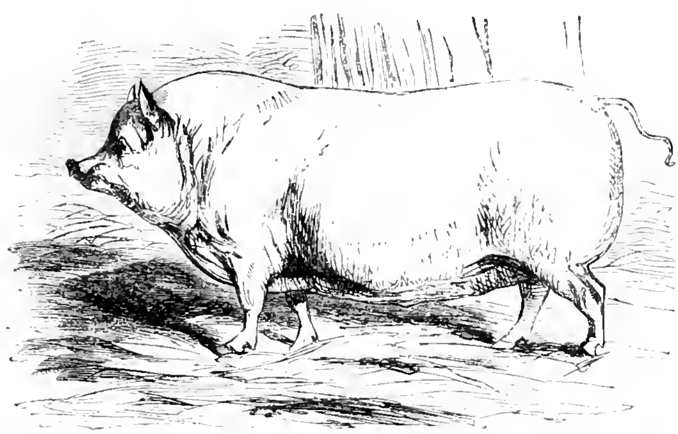
The original breed of Lincoln pigs is white, having a long body, round carcase, fine skin, almost destitute of bristles, a well formed and moderately sized head, erect ears, pointing forward and curled at the tips, hair long, fine, and scanty. In fattening properties they were once considered superior to every other breed except the Berkshire; they frequently attain to 25 st. or 30 st. imperial weight at a year and a half old, and at two years and a half will reach 45 st. to 50 st., although they do not arrive at maturity so early as those of some other breeds. They have sometimes been crossed with the Chinese, which, although reducing them in size, increased their fattening qualities at a less expense of food, the Chinese pigs being very small eaters.

The Old Lincolnshire pigs were far from being profitable to the farmer. They were of a light colour, and had a curly coat of hair, of a medium size, but were long legged, narrow backed, and thick skinned, eating largely, and fattening slowly, seldom reaching above 20 st.

9. THE CHINESE PIG.

The pig is a special object of the Chinaman's attention and solicitude, forming the chief source of his animal food. Vast numbers of them are reared throughout that country and Japan, and much skill and judgment is displayed in crossing the different breeds—with what success we may gather from the excellent types that are brought to Europe from thence. The two species that are chiefly introduced to us are the Siamese, which is black, and the Chinese Proper, which is white. The colour constitutes almost the only difference between them. Crosses of these sometimes produce a piebald species; but in other respects they exhibit no changes of characteristics. Both breeds are small in size, with a neat head, ears small, short, and inclining backwards; bones fine, legs short and small; the back slopes from the head and sinks in the middle, causing the belly almost to trail on the ground. The body is cylindrical in form, the hair short and soft, and nearly destitute of bristles.

Lay, the naturalist, who went out to China with Captain Beechy's expedition, in the work he published after his return, draws a ludicrous comparison between the pig and the Chinese people. "There is," he says, "a striking analogy between these two. A Chinese admires a round face and the smooth curvatures of a tun belly, and, where opportunity serves, cultivates these additions to personal beauty in himself. The Chinese pig is fashioned on the same model. At an early period the back becomes concave, the belly protuberant, and the visage shows a remarkable disposition to rotundity. Nor is the resemblance merely personal; in the moral character there is an amusing similitude, contrariety and obstinacy being the prevailing characteristics of both men and brutes."*



THE CHINESE PIG

So careful are the Chinese of not hindering the progress of their pigs in fattening, that when they want to remove them from place to place, they seldom allow them to walk, but convey them in a kind of cradle suspended upon a pole, and carried by two men. "The difficulty," says the author referred to above, "is to get the animal into his carriage, and this is accomplished by the cradle being placed in front of the pig, and the owner then pulling vigorously at 'porkey's' tail, in the spirit of opposition the animal darts into the place they have prepared for him. At the journey's end the bearers dislodge him by spitting in his face."†

The Chinese are remarkable for keeping their pigsties and the beds of the hogs scrupulously clean. Pork is plentiful enough, but it is too loose and flabby to suit the palate of an Englishman. The natives cut it into thin slices, and fry it in soy, to correct the lusciousness of the fat. They also cut it into long rashers and dry them in the sun, which, however it may improve its flavour, imparts to the diner-out an ugly reminiscence of dog's flesh, which is similarly treated and served up to table.

* "The Chinese as they are," by Tradescant Lay. † Ibid.

The Chinese pigs brought to this country come direct from Canton as sea-stock, and what are left over are sold. It would not pay to bring them over as cargo, unless they could be sold at a very high price. By the former means, however, they have been introduced, and have proved a valuable addition to our domestic animals, most of the present breeds of English pigs having now evident marks of owing their best characteristics to a cross with the Chinese, amongst which we may instance the small head, short and thin snout and jaw, thick chaps, and, above all, that remarkable tendency to accumulate fat at an early age, which is the distinguishing feature of this description of stock at our agricultural shows. The Neapolitan pig resembles the Chinese in most of its peculiarities, and was most probably brought originally from that country. It has been extensively imported into England, and the crosses with the native breeds have been very successful. Some of the Italian farmers, especially in the mountainous parts, keep large herds of swine. Count Chateauvieux, a Swiss nobleman, states that he has seen a herd of 2,000 pigs of the domestic black breed at the farm of Campo Marto. These run all the year round on the open wastes, and are fed with the chestnuts and acorns which the mountain forests supply, and the meat produced is excellent.

The Chinese pig in his "store" state is wild and rather savage. The writer bought some of them when in Ireland, of the pure black breed, which were so ferocious that they would attack any one who offered to get into their sty; and they were so nimble, that when they broke loose it was with no small difficulty they could be caught, and again shut up. They were lean when purchased, but fattened so fast that they were ready for the butcher in a month, although not weighing more than 7 imperial stones.

10. THE IRISH PIG.

"Why, Pat! you give your pig the best corner of the cabin; how is this?" "Faix, yer honner, and doesn't he pay the rint?" Such is the argument said to be urged by an Irish peasant for allowing piggy to occupy the warmest nook of his miserable cabin. The writer has seen in the *one* apartment, an old grandmother bedridden at one corner, a sow and her family in another, and a donkey in a third, the rest of the household living anywhere or anyhow. The pig, in fact, as Sambo said, is the only gentleman in the family.* Let who will suffer from cold, hunger, or fatigue, the Irish pig is sure to have the warmest nook of the ingle, the fullest meal of the scanty pot of potatoes, and he enjoys the most luxurious ease. The playfellow of the children, and the hope of the parent, his title to the supremacy of comfort and enjoyment is undisputed, and he asserts it to the end of the chapter, which only closes at "rint day."

In travelling in Ireland towards a town at which a fair is about to be held, it is amusing to see for the last eight or ten miles a continuous line of peasants, each gently and tenderly driving a fat pig before him, held by a piece of rope or a straw band, generally accompanied by a neighbour or two, to assist him in making a bargain with the chapman he expects to meet at the fair, it being too important a matter to be settled by the judgment of the owner only. Quite as amusing is it to witness the serious consultations of the friends upon the eligibility of the offer made, and—oh! the hardening influence of commerce!—the indifference with which Pat consigns his old

* "De pig is de ony gentleman: massy work, missy work, oberseer work, horse work, nigger work—all work but de pig; derefore de pig is de ony gentleman."

friend to the tender mercies of the butcher or army contractor, upon receiving the *quid pro quo* in hard cash or notes.

The old Irish pig was a detestable brute, without a single quality to recommend him. He was rightly called "the *greyhound pig*," though certainly possessing none of the grace of the greyhound. Tall, long-legged, bony, lop-eared, coarse coated, with large wattles, termed in Irish *sluiddeen*, hanging from the throat; a long snout ornamented with very suspicious tusks, a high-arched back, and a bristly mane, he seemed to be the very converse of everything that modern ideas of swinish beauty and goodness would suggest of perfection. There was much of the wild boar in the character of this animal, and no common fence would confine him, for he would take a hedge or a five-barred gate at a leap with as much ease as his prototype the greyhound.

Amongst other alleviating circumstances, the famine of 1847 swept away this unprofitable breed; and so when the reaction and recovery took place it was necessary to have recourse to a new stock, the old one having disappeared. The introduction of the improved Berkshire, and other of the best English pigs, has placed the porcine stock of Ireland upon a par with our own. This change, amongst many others, has been accelerated by the large infusion of Scotch and English farmers into the agriculture of Ireland, and by the aggregation of the land into large and moderate sized farms. By the operation of this change, capital, as well as skill and knowledge, is diffused and employed throughout the country, and more discrimination is exercised in the choice of the various kinds of domestic animals. The cattle shows of the Royal Dublin Society, share also largely in the merit of the improvement of the breeds of animals of all kinds of the farm.

Richardson, in his work on the pig, states that one, the produce of a cross of a sow of the old breed with a Hampshire boar, was exhibited at the show of the Royal Dublin Society, and gained the first prize. "It weighed over 41 st., was the property of a humble cottager, by name Peter Flood, who expatiated to us with no small pride and apparent pleasure, upon the facility with which the animal had put on flesh, and the *very small proportion of feeding* that had sufficed to render him the truly respectable looking fellow he was."* Large numbers of Irish pigs are annually sent to England, chiefly in the "store," or lean state. The same author just quoted relates from Moubray, that in the spring of 1830, a drove of Irish pigs, amounting to 14,000, passed through a turnpike in the west of England; and Youatt says that in 1837 no less than 595,422 pigs were imported into England from thence, the number in 1821 being only 105,501, so much had steam navigation increased the trade between the two countries.

* Richardson on "The Pig," p. 50.

SECTION XXIX.

THE RABBIT.

The less the farmer has to do with these destructive animals out of doors the better. In no instance can they be encouraged without inflicting serious injury upon both the fences and the crops. We have already expressed our opinion of the practice of some landowners, who make provision for the multiplication of these vermin, by in part paying their gamekeepers with them. To show the extent to which these men, thus encouraged to keep up a large head of them, will quickly effect their purpose, take the following calculation:—Suppose a pair of rabbits turned into a plantation. These animals in a state of nature are said to breed eleven times in the year, bringing forth, on an average, eight at a birth. Let us, however, say that on an average they breed eight times only, and further suppose that half the progeny are males, and consequently only the females are capable of increasing the number. Again, supposing that none are killed the first four years, the result will be as follows:—

First year—One pair breeding 8 times and bringing forth 8 each time	$1 \times 8 \times 8 =$	64
Second year—32 females	$32 \times 8 \times 8 =$	2,048
Third year—1,024 females	$1,024 \times 8 \times 8 =$	65,536
Fourth year—32,768 females	$32,768 \times 8 \times 8 =$	2,097,152
	Total increase in four years . .	2,164,800

That this calculation is not far from the truth is proved by the experience of those farmers who are cursed with landlords that practise the disgraceful fraud we have denounced, and which is neither more nor less than making the tenant pay the keepers double and treble the amount of their actual ill-gotten wages, by the destruction of their crops.*

The only description of country in which rabbits can be profitably kept in warrens, is where the soil consists of sandy hills, incapable of profitable cultivation, and even these must be enclosed by stone or turf walls, or fences four feet high, to prevent the rabbits from ranging over the cultivated districts adjacent, which they will otherwise do for miles. In Norfolk, Suffolk, Yorkshire, &c., there are extensive tracts of this description of land, that are fit for nothing else than rabbit warrens, to which purpose they are accordingly devoted. Those in the neighbourhood of Brandon, in Suffolk, and Thetford, in Norfolk, supply the London market with immense numbers of these animals.

In the domesticated state, rabbits, if properly and judiciously attended to, may be made to yield a considerable profit. In Holland, Belgium, and France they form an important item in the economic management of the small occupations, and large

* A case was recently brought into the Assize Court for the county of Hertford, in which it appeared that a land-owner had sold the right of shooting and sporting over his property, which was let to respectable tenants. The fellows to whom the manor was let, not contented with the natural increase of the game on the property, employed a gamekeeper *to purchase hundreds of live rabbits*, which were turned loose, and, as may be supposed, soon overran the estate in thousands. The tenants were compelled to abandon their farms, and one of them brought an action against the parties for the destruction of his crops. But such was the intimidation or the influence brought to bear upon the jury, that although the cause was twice tried, a verdict could not be obtained, to the disgrace of the county. The plaintiff has, therefore, moved for a writ to remove the cause into the Court of Queen's Bench, in London, which has been granted, and we now trust that ample justice will be done to the principal actors in this infamous affair, although the landlord is equally culpable with them.

numbers are weekly exported from Ostend and other ports to England during the proper season. These are generally of the large white breed, which are preferred by the breeders on account of their fur, which is long and thick, and sells readily to the furriers, and the hat-makers, the latter of whom substitute it for beaver fur in their manufactures. At the time of year when the fur is loose the breeders pull it off, and they affirm that so far from suffering pain from the operation, it appears rather to give the animals pleasure.

Rabbits are capable of reproduction at six months old, but the breeders do not allow the does to be put to the bucks before nine months, and they leave them together only about ten minutes. The period of gestation is thirty days, and the buck is admitted again immediately after parturition, so that the doe is capable of producing every month. The fanciers, however, generally take two litters every three months, when in confinement. The number of young produced is from four to twelve, but with tame rabbits it is usual to destroy all over six, which, it is considered, are quite enough to be brought up profitably. No control can, of course, be exercised over the wild rabbits; but their numbers are greatly reduced by the numerous enemies which always frequent a warren—such as hawks, kites, polecats, weazels, &c. &c. In addition to these, the bucks themselves destroy great numbers of the young when they can get to them. In the domestic state the bucks should be kept separate after six months, and never allowed to associate with the does during the period of gestation, or the two sexes will quarrel and tear one another to pieces. They will continue to breed for five years if properly managed, but the bucks will not continue efficient more than two or three years.

On a farm the rabbits generally have their burrows in the hedges, on which they make great havoc. Their nests, however, are made in the open field amongst the corn. In this case they make a burrow, and then form the nest in it, with the fur from their own breast. They suckle their young twice a day, carefully covering the mouth of the burrow with mould every time they leave.

Tame rabbits should be fed regularly three times a day, *i.e.*, at eight in the morning, two, and six o'clock in the afternoon. Only sufficient food for the meal should be given them, as they will not eat what remains unless compelled by hunger, which should never be allowed. Never give them vegetables in a wet state. Bread, oats, or dry roots, such as potatoes, carrots, and parsnips, are good at one of the meals. Avoid giving them weeds or vegetables in a bad state, as they will cause them to scour.

Hutches are generally used for keeping rabbits. If they are in tiers, the upper ones should be so arranged that the droppings should not fall into the lower. The does' hutches should have two compartments, but the bucks need only one. The droppings should be carefully preserved, as they are equally valuable as guano for manure, and two loads are quite sufficient for an acre of land. The hutches should be kept dry and scrupulously clean. The dung is considered almost valuable enough to pay for the keeping of the animals. The Angora and the Lop-eared are the best to keep in hutches; both have long fur, but they are of delicate constitutions, and require to be kept warm.

The food of rabbits should be solid and nutritious to render them profitable. Corn, and that of the best quality, and as much as they will eat, with a fair supply of good vegetables, will keep them in health, whilst inferior food, and the refuse of vegetables, will engender disease; the former will yield a profit, but the latter is sure to incur a loss. Oats, barley, peas, and wheat, are equally acceptable to them. Pollard and buck-wheat are also good. Parsnips, carrots, Jerusalem artichokes, baked or steamed potatoes;

and for green food lucern, cabbages, clover, tares, and furze. Meadow and clover hay are both good for them. In short, to vary the food, and always to let it be of the best quality, is the only plan to make the keeping of rabbits profitable. Some of the larger breeds have been fattened in a few weeks to from 15 lbs. to 20 lbs. weight. Many of these kinds have been sold as high as 5 guineas each.

Again, in conclusion, we would say to the farmer, never take a farm the landlord of which preserves the rabbits, or allows the keepers the privilege of keeping up a head as a portion of his wages or perquisites. Such farms are not worth 5*s.* an acre, whatever may be the quality of the land, independent of the constant state of warfare between those privileged spies and the occupier, which is sure, sooner or later, to involve him with his landlord. Moubray mentions a farm, the produce of which was wholly destroyed by rabbits. It was situated near some preserves; "but," he goes on to say, "it is equally unfortunate for a farmer to be fixed near to, or within some miles of a warren, since they will travel a great distance to feed, either upon corn or vegetables; and, if the soil and corn be to their liking, will always remain in sufficient numbers to stock a new district. At the same time they are good and profitable stock in a domestic state—infinitely more so under good management than in their wild and exposed state; and their dung is extremely valuable on a farm."

A river may be considered as an effectual barrier against the inroads of a colony of these vermin, but there are circumstances under which it forms no protection. In the year 1796, or 1797, the writer was residing with his father, who had an estate situated on the banks of the Yare, in Norfolk. On the opposite bank was an extensive rabbit warren, well stocked at all times. The winter of one of the years referred to was a very severe and protracted one, and the Yare for many weeks was wholly frozen over. The consequence was, that the entire colony of rabbits *migrated across the ice to the opposite bank*, and the estate in question thenceforth swarmed with them for many years. In proof of the severity of the winter that year, two gentlemen, one of whom was the Rev. Mr. Munnings, of Gressenhall, skated from Gressenhall to Norwich along the Yare (the distance being at least twenty miles), only landing at the mills on the passage.

SECTION XXX.

THE POULTRY YARD.

However insignificant the smaller denizens of the farm may appear in the eyes of an English farmer, who numbers his oxen by the hundred, and his sheep by the thousand, they are far from being contemptible as an object of profitable cultivation if properly managed, and on a scale commensurate with the size of the farm. At present the produce of the poultry yard is considered the perquisite of the farmer's wife or daughters, who thereby supply themselves with clothing; or even, in some cases we have known, the produce goes towards paying the grocery, as well as the linen-drapery, bill. By this method of disposing of the produce, the farmer himself is relieved from paying attention to a kind of stock which, as a matter of fact, he considers much below his notice (except when they make their appearance at the dinner-table), and only fit to be superintended by the females of the family.

Such is not the case with the French and Belgian farmers. It is true that generally speaking the farms are smaller in those countries than in England; but the keeping of an extensive *basse-cour*, or poultry yard, is not confined to the small occupiers, the larger ones making it an equally important object of rural economy, by which the inferior grain is disposed of at a fair profit without being subject to much, or any, fluctuation of prices. To show the justness of the importance attached to this branch of rural economy on the Continent, we adduce the following account of the number of eggs imported into the United Kingdom in ten years :—

		Brought forward .	564,628,098
1852	115,526,245	1857	126,818,600
1853	108,281,233	1858	134,684,800
1854	123,618,020	1859	148,631,000
1855	99,782,800	1860	167,695,400
1856	117,419,800	1861	203,313,360
	564,628,098	Total . . .	1,345,772,258

Of the importations of poultry we have no regular account since 1856, but the following is given in the publications of the Board of Trade as the annual imports up to that date :—

Poultry Imported in the Years 1854, '55, and '56.

1854	value	£38,876
1855	,,	42,075
1856	,,	48,230
		£129,181

If we reckon the cost of the eggs at only 4*d.* per dozen, the value of the eggs averages in the ten years £186,912 yearly, or an aggregate of £1,869,126 sterling; and if the poultry are added, the value would probably reach £2,500,000 in the ten years. If the same number were raised in this country, the value would be still greater, it being well known that English eggs and poultry are much superior to those imported from the Continent.

Surely, then, this statement is sufficient to show that the breeding and rearing of poultry might be carried on with advantage in England to a much larger extent than it is at present, and that it is far from being beneath the notice of the large farmer. The quantity of poultry consumed in London alone is enormous, as the following statement shows :—

Poultry sold annually at Newgate and Leadenhall Markets.

	Alive.	Dead.	Total.
Game, &c.		910,000	910,000
Domestic fowls .	60,000	1,756,000	1,816,000
Geese		1,002,000	1,002,000
Ducks	40,000	383,000	423,000
Turkeys		124,000	124,000
Pigeons		383,000	383,000
	100,000	4,558,000	4,658,000
Sold by Poulterers and Shopkeepers			350,000
		Total . . .	5,008,000

If any further stimulus were wanting to cause a more extended attention to this object, we have the praiseworthy example of our beloved sovereign, Queen Victoria, who has formed an extensive poultry yard, the management of which she personally superintends, and is never more pleased or happy than when surrounded with these pets of the *basse-cour;* nor has this example been without its influence already, as may be seen in the extraordinary display of the feathered tribes at the Agricultural Shows at Birmingham, and at the Crystal Palace at Sydenham, at both which the exhibition of fowls and poultry of every description proves what might be done, if proper attention was more generally paid to them. At the Birmingham Cattle Show, in 1852, there were 1,200 pens of poultry; and one pen, consisting of a Spanish cock and four hens, sold for fifty guineas, and a Cochin Chinese Cock brought the owner £25. A pair of Poland fowls also, cock and hen, sold for eighteen guineas.

The London market is chiefly supplied with poultry of English breeding from the counties of Essex, Surrey, Hampshire, Berkshire, and Buckingham. At Wokingham, in Berkshire, the rearing and fattening of fowls for the London market is the chief business of the place, and many families are almost entirely supported by it. The Dorking fowls, too, are much esteemed in the metropolis, and large numbers of them are fattened there for that market. Most of the capons sent to London are reared and fed there and at Wokingham. Lincolnshire, Cambridgeshire, and Norfolk chiefly supply the English geese and turkeys consumed in London; and the former constitute a very important part of the rural economy of the fens and marshes of those counties. But the railroad system of the kingdom, being ramified into the remotest districts, facilitates the conveyance of all kinds of provisions, whether alive or dead; and the wonder is, that this does not induce the farmers to pay more attention to this source of profit, and endeavour to keep at least a part of that supply in their own hands, of which the foreigner now enjoys so large a monopoly.

We are not alone in our estimation of the importance attached to this subject. Since the stimulus given to the rearing of poultry by the introduction of the Cochin Chinese fowls, many writers have come forward to urge the desirableness of extending the rearing and fattening of fowls, and making it a regular part of the business of the farm. One of these, writing in the *Times* newspaper (and quoted in the "Poultry Book"), says:—"We speak with the more earnestness on account of the very considerable margin for improvement actually existing in the present state of our poultry markets. The price paid for fowls in London is preposterously high, even according to their present rate of multiplication and increase; and if by crossing the breed with these interesting importations (the Cochin Chinese), the productiveness of the general stock should be augmented, it will be out of all question that such prices should continue. If the poultry fanciers of the present season are really discharging any public duty, they must needs anticipate greater cheapness and greater abundance in the breed of our domestic fowls. We really feel compelled to assume that the Cochin Chinese variety cannot, even in the eyes of fashion, be considered simply ornamental, and that its merits must needs reside mainly in its uses. More eggs, therefore, and more fowls of a better description, ought to be ultimately producible, and this improvement ought to act on the markets of the country. There is no reason why poultry should not be considered as a species of agricultural stock, and be turned to as good account both for producers and consumers. The consumption of fowls, in fact, is exceedingly large; and, but for their unnecessary costliness, would be still larger. For this unnatural price there is no kind of excuse. The means of transport provided by railways so completely answers all purposes, that every county in England may either transmit its produce to London, or select its own market elsewhere, at a very small cost of time or money. Fowls, too, travel more easily than any other animals. They can be despatched alive or dead with equal facility, and there are no gate dues or taxes to heighten their price on a metropolitan market or stall. Yet, although 2*s*. 6*d*. a couple would, according to all calculable expenses, be a remunerative charge, we are compelled to pay at least double."

Another writer, in the *Agricultural Gazette*, says:—"For good poultry there is always a sale in London, and where there has not hitherto been, they will supply (or create) one; for the fact that they are to be had of good quality, will cause application to be made for them; but in London there is always a demand. Like all other provisions, there are different periods for different prices, and here it is that poultry-shows do much good in offering premiums for early maturity. If those who have facilities for rearing chickens will do so in January, or even in December, and bring them to market in a fat state in April, May, and June, they cannot fail to receive a remunerating price. Three pounds per dozen is a common value for fowls four months old. At this season (January), less than 2 guineas would be ridiculously low."

A collateral advantage to the farmer would arise from the consumption of the inferior sorts of grain. We do not mean inferior in quality, but of kind; for it will not answer to give fattening fowls anything but the very best barley, peas, &c., whatever may be given to the growing ones. Some of the Lincolnshire farmers, who keep geese in great numbers, consume by them a hundred quarters of corn in the season at a good profit, charging it to the fowl account at the full market price.

Looking, therefore, at the constant, large, and increasing demand for poultry in London, and the possibility of increasing indefinitely the consumption in the country also, there is every inducement for the British farmer to direct his attention to this branch of rural economy, and to give to the business of rearing and fattening fowls that place in the ordinary management of the farm, to which its importance entitles it.

SECTION XXXI.

THE DIFFERENT BREEDS OF POULTRY.

The common English fowls, *Phasianus Gallus*, are said to have their origin from the jungle fowl of India, or from Persia, from whence they have been disseminated over every country of the known world. The numerous varieties, arising in the first instance from the influence of climate, situation, food, or accident, have been further multiplied, like those of all other domestic animals, by innumerable crossings of the different breeds; whilst the size of many of them has been increased by greater attention to the breeding and rearing, and the selection of the best types for that purpose. Besides, therefore, the strictly native fowl of Britain that peculiarly belongs to it, there are other denizens of the poultry yard which have been imported from time to time, and have become naturalised amongst us, a short account of which may prove both interesting and useful to the reader, especially as most works on agriculture have omitted the subject altogether, or given the most meagre account of it, as if it was not worthy the attention of the farmer. The following list comprehends the principal breeds of poultry at present acknowledged in the United Kingdom:—

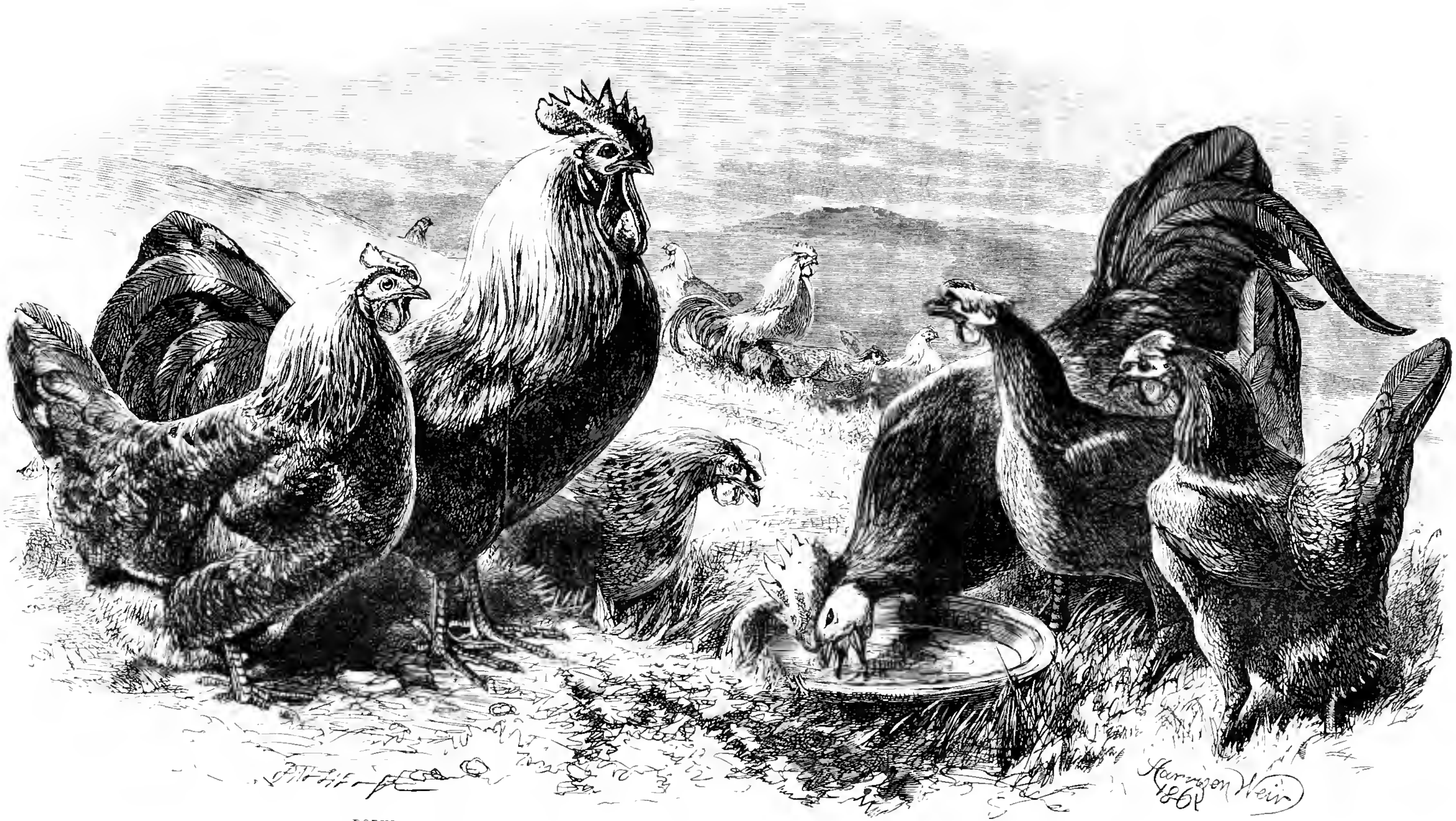
1. The Dorking.	7. The Bantam.	13. The Turkey.
2. The Game.	8. The Frizzled.	14. The Pea Fowl.
3. The Polish.	9. The Silk.	15. The Guinea Fowl.
4. The Hamburgh.	10. The Shanghae.	16. The Swan.
5. The Malay.	11. The Rumpless.	17. The Goose.
6. The Spanish.	12. The Barn-door.	18. The Duck.

1. THE DORKING FOWL.

The Dorking fowl is considered to be the descendant of the ancient race of English fowls, having existed in the country "time out of mind" beyond the Roman conquest, and probably crossed with others brought over by the conquerors. Certain it is, that the description of the Roman fowls given by Columella corresponds singularly with that of the Dorking breed, as the following quotation shows:—"It is not advisable to buy any but such as are prolific. They should be of a plumage very red, or tawny with black wings. Let the whole be of the same colour, or of a near approach to it; but if of any other colour, let white fowls be avoided, for they are tender and less robust; neither is it easy to find specimens of them that are prolific. Let the breeding hens be of a choice colour, of robust body, square-framed, large and broad breasted, large headed, with small, erect, bright red comb, white ears; and of those thus characterised let the largest be procured, and not with an even number of claws. Those hens are reckoned of the purest breed which are *five-clawed*, but so placed that no cross spurs arise from the legs; for she that has this male-like appendage is rarely fruitful, and when she does sit she breaks the eggs with her sharp claws.

"The cocks should be lustful, coloured like the hens, with the same number of claws, but taller, proud of carriage, combs erect and blood red, eyes brown or black, beak short and hooked, ears very large, and very white; wattles looking whiter from their shining, and hanging down like a hoary beard; the feathers of the neck or mane varying, but preferably from yellow to golden, and spreading down over the shoulders; the breast broad and muscular; the wings brawny, like arms; the tail lofty, and composed of a double row of arching feathers, alike on each side; the thighs ample and usually thick-clothed with coarse feathers; legs sturdy, not long, but armed, as it were, with dangerous spears. Even when prepared neither for fighting, nor for the triumph of victory, their temper should be shown to be highly generous, haughty, active, watchful, and given to crow often; also not easily alarmed, for sometimes it will be needful for them to repel attacks, and to protect their conjugal flocks."

One would almost suspect, when reading the above minute description, that it was the composition of a regular Bakewellian improver writing upon the Dorking breed, so just is it in its principles, and minute in its details, which evidently prove that both the white and the red or grey Dorkings were familiarly known by the author. How long the town from which it receives its name has been noted for the breed no one seems to know;



DORKING.

SPANISH.

but writers on agriculture more than a century ago, speak of it as rearing an incredible number of fowls, remarkable for their size and fine flavour, and of capons weighing at Christmas 7 lbs. or 8 lbs. each, which then sold at 5*s.* apiece.

There appears, however, to be a doubt whether the present improved breed is the original fowl of the Dorking district; and those who have been long acquainted with the subject, are of opinion that the old five-clawed type has been crossed with a larger bird common in Sussex, whilst others, equally well informed, declare that no one who possessed the Sussex breed would on any account cross it with an old Dorking. At the same time, the distinguishing mark of the latter being the possession of the fifth claw, it has been the object of the breeders to select their stock fowls with reference to the retention of the additional member, and to throw aside all those in whom it was wanting. From this fact, however, we may draw the inference that the double hind claw is not a *certain* distinguishing mark of the present Dorking fowl, and that good poultry are reared in that town destitute of it.

There are several varieties of the Dorking fowl, the principal of which are the Grey Speckled, which include the sub-varieties of the Spangled, the Japan, the Silver, the Pencilled, the Golden, and the Red Speckled; and the White, which is smaller and lighter by 1 lb. or 2 lbs. than the Grey. They are also, like Columella's white fowl, of more tender constitution than the Grey, and are less suited to a northern climate. They are, however, very beautifully formed birds, and on this account are great favourites with amateur fowl fanciers, and will doubtless always continue to hold a distinguished place in the *basse-cour.* The Grey Dorking when in full plumage is a magnificent bird. The cock displays a rich and rare combination of colours; and his long hackles gracefully thrown over each shoulder, of light yellow, tipped with dark brown or black, with saddle feathers similarly coloured, contrast beautifully with the green sickle-formed tail feathers, and the still darker ones of the wings and body.

2. THE GAME FOWL.

Thanks to the advance of civilisation, and the humanising spirit of the present age, the cock-pit, in which this beautiful and courageous species of the feathered tribes was made to contribute to the brutal amusement of a set of barbarians, has been abolished, and a penalty is attached to those who shall have the temerity to revive it. Notwithstanding this, the breed is so valuable, as well as ornamental, affording both profit and pleasure to those who possess it, that great numbers are still reared throughout the country; and, although the Game-cock claims, and will maintain the pre-eminence in the poultry yard, when this is conceded to him (which, after a trial or two of prowess, is generally the case), he does not object to associate with other fowls; and far from helping to maintain strife amongst his companions, he frequently exercises his influence in compelling other combatants to keep the peace.

Game fowls are the most slender and delicately formed in body, neck, legs, and beak, of any breed. Their colours are bright and beautifully variegated, and their flesh is white, and particularly well flavoured and tender. In size they are rather below that of the common fowl, but for symmetry and delicacy of limb, they may be compared, amongst their compeers, to the race-horse amongst other breeds of that animal. The greatest objection to the Game fowl is the difficulty of rearing them; for such is their extreme pugnacity of disposition, that they are scarcely out of the shell before they begin to quarrel and fight, so that whole broods, it is said, scarcely feathered, are sometimes stone blind from fighting, to the very smallest chicken. They then mope in corners, but upon regaining the first ray of light, they will renew the battle.

At five months old the game chickens, if well tended and fed, will weigh $2\frac{1}{2}$ lbs. to 3 lbs. each; and such is the estimation in which they are held, that they will sell readily at 5*s.* 6*d.* or 6*s.* the couple. They require considerable attention the first few weeks; but as soon as they are able to run in a grass field, can pick up the greatest part of their subsistence till put up for fattening. A celebrated physician at Liverpool, says the author of the "Poultry Yard," "once declared his conviction that there was more nutriment in one of the Knowsley Game fowls, than in the largest capon that the London market could possibly produce."

Game fowls are so largely distributed throughout the world that it is difficult to trace their origin. We have reason, however, to believe that many of our own Game fowls are a cross between the common Barn-door hen and the cock pheasant. It is well known that the latter birds are remarkable for their pugnacity of temper amongst themselves; and their contests have been known to be so determined, that both combatants have allowed themselves to be taken rather than give up the fight. M. de la Gironiere relates in his "Twenty Years in the Philippine Islands," that, "on one occasion he heard 40,000 francs betted upon a cock that had cost 4,000 francs (£166), and in a few minutes this costly champion fell, struck dead by his antagonist."

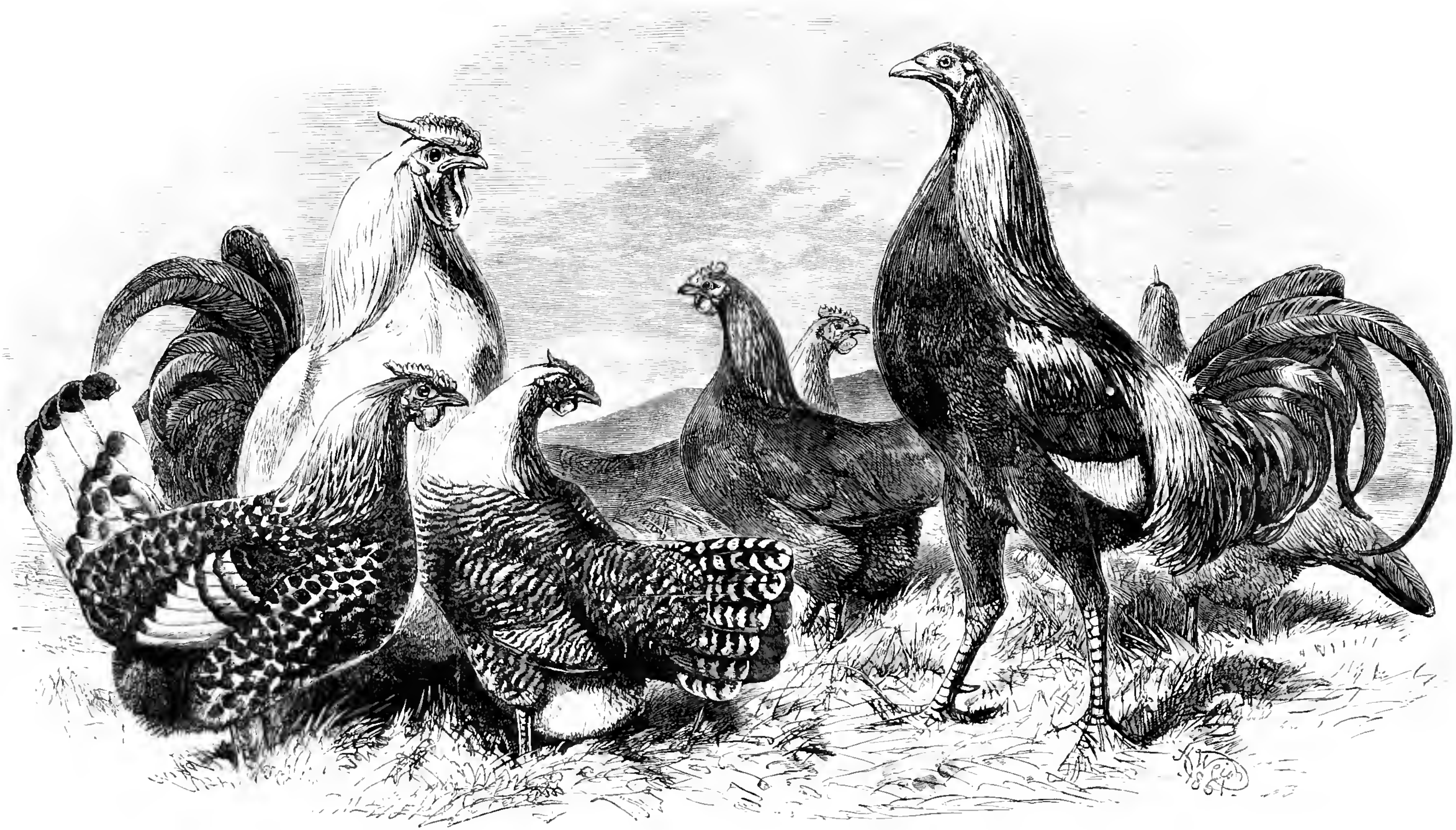
3. THE POLISH FOWL.

This breed is distinguished by the large tuft of feathers on its head, which is common to all the varieties of it. There is, however, a difference of opinion respecting other peculiarities which some of them possess, amongst which is a small spiked comb resembling the horns of a crescent, which has usually been looked upon as a distinguishing mark of the purity of breed; but others consider it an innovation, the possessor of it being rather the "Tufted Hamburgh," than the Polish race.

The Polish fowls in all their varieties are remarkably beautiful, and will always be favourites on account of their ornamental forms. But in addition to this, they are equally useful on account of the number of eggs they lay, and their disinclination to sitting, in which they differ from most other breeds. On this account they are called "everlasting layers," and their eggs are usually put under hens of the common breed to be hatched. They fatten quickly, and their flesh in some respects resembles that of the Turkey, but is more juicy, and the flavour is richer. The imported fowls have uniformly been black, so that the varieties of colour amongst them must have proceeded from crossings.* The most esteemed of these varieties are the White Crested Black, the Golden, bearded and unbearded; the Silver, bearded and unbearded; the Cuckoo, bearded; the Grey, or Grizzled, bearded; the Black and White Speckled, unbearded; the Blue and White Top Knots, unbearded; the Yellow Spangled, bearded; the Black Crested, bearded; the White, bearded.

The most remarkable feature in some of these varieties is the beard, which is thus described in the "Poultry Book:"—"Immediately below the cheek, and covering the

* Boswell's "Poultry Yard."



SPANGLED AND PENCILLED.
HAMBURGH.

GAME.

front of the throat, there is a collection of elongated feathers, regularly imbricated and of triangular form; the broadest part, or base, is uppermost, extending in a line as whiskers below the eyes. These feathers, from the base to the point below, should occupy a space of about two inches." The Black White-Crested have no beard, but in lieu of it the cock has formidable red wattles, hanging from the level of the eye on each side of the beak. The colours of the Golden Spangled are extremely varied and splendid, whilst the form of all the varieties, independent of the peculiarities of the crest and the beard, is all that can be desired in a fowl, whether in relation to ornament or use. "His carriage," says the same author, "is remarkably good, the arched neck nearly meeting the tail, which is very full and erect, especially when the bird becomes excited. The breast is wide and prominent, while the short legs and generally compact form are no less pleasing to the eye than valuable in an economical sense, as indicative, technically speaking, of the comparative absence of offal. A full sized Black Polander cock should weigh from 5 lbs. to 5½ lbs. When we turn to the hen we require the same colour throughout; but the crest must be globular and white, the wattles rounded and well developed, the ear-lobe white. In form she is of still closer build than her husband, and at maturity, should weigh about 4 lbs."*

The Polands require a warm sheltered situation on a sandy soil. They begin laying early in the spring, and continue until they moult, sometimes with very brief intermission in the winter. On a moderate average, the number of eggs yearly would be 150, but some have been known to lay 280 in one season. The White-Crested Black are considered the best layers, and their eggs, which are pure white, average 2 ounces in weight each. The number and value of the eggs must be set against the difficulty of getting them to hatch eggs, which is a prevailing defect, especially with the bearded varieties. When to this is added their excellence as table fowls, it is not surprising that many farmers who look to the profit on their stock, should prefer and patronise them. They are, however, scarcely hardy enough to stand the roughing of a farm-yard.

4. THE HAMBURGH FOWL.

This bird is called by Aldrovandus *Gallina Turcica*, or Turkish fowl, being, like all the European fowls, referred to Eastern countries as their original home. By what title it claims the name of Hamburgh appears to be questionable, unless it was first carried thither from Turkey by the Levant merchants, and thus found its way to Britain. They have been known here as Hamburgh fowls since the beginning of the fourteenth century, if Chaucer's exact description of a cock in his possession is any rule, answering as it does to that of the present Golden Hamburgh.

There are several varieties of this breed, as the Silver Pencilled, the Golden Pencilled, the Silver Spangled, the Golden Spangled, and the Black Hamburgh.

The Silver Pencilled Hamburgh has many designations in different parts of England, as the Bolton Grey, because it is extensively cultivated at Bolton in Lancashire; the Creole, from the intermixture of black and white (a misnomer, as the term does not refer in the West Indies to the offspring of a black man and white woman, or *vice versâ*, but to those born of European parents in the islands); Pencilled Dutch, because

* The "Poultry Book," p. 158.

imported from Holland; Dutch Every-day-layers, on account of their productiveness as layers, &c. &c.

The Silver Pencilled Hamburghs are characterised in both sexes by their peculiar compact and neat forms. "The cock has a full, bright-red rose comb, ear-lobes white and large; wattles large, round, and red; head small and fine; beak short and white; plumage entirely white, with the exception of the wings and tail; the wings barred very regularly with black; the tail ample, very erect, measuring nine inches to the top of the highest curve of the sickle feathers, which are of unusual length, and with the rest of the tail feathers of a highly iridescent black, their edges only being very slightly margined with white, silvering as it were the whole plume. Mottled feathering is objectionable in the tail; but comparatively few birds attain the more perfect form described above. Height may be placed at sixteen inches, while an average weight would reach to $4\frac{1}{2}$ lbs."*

The Golden Pencilled bird differs from the above in having a yellowish buff, or bay, ground-colour in its plumage instead of white, and it is rather larger. Both are extensively bred in Lancashire, and are equally good layers.

The Silver Spangled Hamburghs are larger and more stoutly framed than the Silver Pencilled; the spangle is of course at the point of the feathers, and appears on the hackle, breast, back, and wing-coverts. The tail is white with black tips.

The Golden Spangled Hamburgh is known in England as the Golden Pheasant, from the resemblance of its spangled feathers to those of the cock pheasant. The tail, however, is different, as well as the comb, which is very long, nor does its form altogether resemble the pheasant. The plumage is exceedingly brilliant, compact, and close. They are extensively reared in Yorkshire, Lancashire, and the neighbouring districts, where there are poultry clubs, which publish tables of the points of excellence required in these birds, as a guide in rearing them for competition.

The Black Hamburgh has a plumage of glossy, rich, green-black, and in other respects resembles the other Hamburghs in form, being doubtless only a variety of the same family. They do not do well in confinement, requiring the run of a clear dry pasture or common. They are strong on the wing, and it is necessary to have at least six-feet fences to confine them within their limits. This holds with the Hamburgh fowls generally. The black are abundant layers, but uncertain sitters, and their eggs are usually hatched under hens of other breeds. Perfect cleanliness in the fowl-house is as necessary to the health of the birds, as it is to the perfection of their beautiful and variegated plumage.

5. THE MALAY FOWL.

There is no error regarding the native country of these singular birds, which although accustomed to a tropical climate, are found to acclimatise themselves in our comparatively high latitude without suffering much by the change. Brought over in our East Indiamen as ship-stores their remarkable stature attracted the attention of amateurs, and they were purchased eagerly by them. Colonel Sykes, however, appears to have been the first person who imported any of the breed directly for the purpose of propagating the species. In 1831 he imported two cocks and a hen, which appear to have

* "The Poultry Book," p. 180.

been a variety of the same breed. One of the cocks stood twenty-six inches to the crown of his head, and measured twenty-three inches from the tip of the beak to the root of the tail. These birds were called Kulm fowls, but in every respect they resemble the Malay. They suffered nothing from the change of climate, and in 1832 the hen reared two broods.

Previous to the introduction of the Shanghae fowl the Malays were always resorted to when it was desired to increase the size of any other breed, and they then constituted the most striking feature at the exhibitions of fowls, especially in Ireland, where they had been introduced by Mr. Nolan, of Dublin, who purchased some of them at the London Docks. These were brought direct from the Peninsula, and were the means of propagating the pure breed in every part of the United Kingdom. Tall as these birds are, such is their graceful carriage that they are far from having an awkward appearance. Bold and fearless in their gait, their commanding stature gives them a superiority over every other fowl in combat, whilst their great strength of limb and beak makes them formidable antagonists.

In point of fact their pugnacious disposition, both in the male and female, is such that it is dangerous to the other inmates of the fowl house. The cock especially is both quarrelsome with his neighbours and cruel towards his own offspring. But the hen is not behindhand in a vixenish temperament, and amongst her compeers displays all the pride and hauteur of a court beauty. Their colour varies as much as in any other breed, exhibiting all shades from white to jet-black; but the beak and legs are uniformly yellow in the pure breed. The head of the cock is small and finely-shaped, with a low comb and small wattles. The beak is strong and hooked, the eye deep sunk and piercing; the plumage close and smooth, and the most approved colour is a dark chestnut, approaching to black on the breast, back, and thighs; the neck, hackles, and saddle feathers are a brilliant maroon, particularly glossy on the upper surface, and inclining to yellow underneath; the wing-coverts metallic green; the back slopes rapidly from the long neck to the tail, which is long and flowing, but rather scant of feathers; the sickle feathers very long and tapering, and black with a purple or green metallic lustre, varying with the angle of light falling on it. Unlike those of other breeds, the neck feathers of the Malay are the same length from the head to the shoulders, which takes off much of that graceful slope which is seen in the Hamburghs and other breeds.

The Malays will fatten up to 10 lbs., and the usual height of the cock is twenty-eight inches. The fowl that won the large silver medal at Birmingham in 1852 weighed $11\frac{3}{4}$ lbs., and Mr. Rutherford had one that weighed 13 lbs. without being fattened. The hen is about one fourth smaller than the cock. She has a small head, a short yellow beak, pale crimson face, reddish-brown neck hackles, back and wings a dark brown; the neck feathers, like those of the cock, uniform in length; and fine tail feathers on each side. Her usual weight is about $8\frac{1}{2}$ lbs.

Besides this, there are other varieties, some the produce of crossings with other birds. Of these the White Malay, both cock and hen, are pure white in their plumage, except that the neck hackle and saddle feathers are slightly tinged with yellow. They are smaller than the brown variety. The Pheasanted Malay is considered to be a cross between the Malay cock and the Golden Hamburgh hen. The head of the cock resembles that of the Malay, but the plumage is quite different, the neck hackle being black with a green lustre, the back and rump black, tail less strongly curved, and legs white. The hen has black neck hackles like the cock, partridge-coloured rump feathers spangled with dark-brown, white legs, dark brown and very upright tail, breast light brown spangled with black, or very dark brown.

The Malay fowls are not considered good layers, but few of their eggs prove abortive. The hen usually begins laying in March, and lays twenty-four eggs before she shows a desire to sit. She sits closely and well, consequently, unless she is disturbed, her eggs seldom fail of producing a chick. Her long legs, strong claws, and heavy tread render it necessary to watch her some days after hatching, to prevent her crushing her young ones in her anxiety to provide food for them. The chickens feather slowly, which renders it the more necessary to hatch them early—not after June—that they may be provided against the vicissitudes of the autumn and winter of our northern climate. They are awkward looking creatures, long-legged and gawky, until they are full grown.

6. THE SPANISH FOWL.

This breed of poultry, more or less diverging from the original type, is found in abundance in all the countries bordering on the Mediterranean Sea. No attention is paid to the breeding of these fowls in those countries, consequently the pure breed can hardly be obtained, or even looked for. The great object is to rear immense quantities of them, in which the natives of those parts far exceed the English fowl-breeders; but it is impossible to obtain specimens worthy of the attention of the English fanciers who look for something beyond prolificness. They have, therefore, searched in other countries for the true type of the Spanish fowl, and have found the best in Holland, where it is supposed it was introduced so far back as when that country was under the Spanish yoke. Latterly, however, some fine specimens of this breed have been obtained from Spain by Captain Hornby and others, but none excel those from Holland for purity of blood.

In England they have long been favourites, being probably brought over early from Holland. They are capital layers, and are said to continue laying ten months of the year if well fed and housed, laying six eggs per week, from February to August. The average weight of the eggs is $2\frac{3}{4}$ ounces, but some have been taken that weighed $4\frac{1}{2}$ ounces, the colour being a clear white. They are bad sitters and cannot be trusted, therefore the eggs are usually hatched under hens of other breeds. They should not be put under the hen earlier in the year than April, and they require great care the first fortnight after hatching; after which they become as hardy as other breeds, but are at least ten weeks before they are full fledged. The following is a description of a good Spanish fowl of the Andalusian variety:—"The cock should have a large, erect comb, evenly serrated; white cheek, blueish legs, blueish grey or dove-coloured plumage, each feather being lightly margined with a darker tint; glossy hackles of velvety black, falling evenly on each side of the breast, in strong contrast to the colour of the latter; tail full, carried very upright, with the sickle feathers well arched. The hens have the same colour, but pendant combs."* The cock birds weigh on an average about 7 lbs., and the pullets about $5\frac{1}{2}$ lbs. each.

* "Poultry Book," p. 111.

The Black Spanish is thus described:—"The male—head large, beak of moderate size, eyes very bright, comb single, upright, very large, red as coral, and slightly serrated; face and cheeks perfectly white, the white extending round the eye; wattles long and pendulous; neck of moderate length, but strong; body broad and close-feathered; wings of medium size; rather long in the leg, which is of a bluish white colour; tail a good plume; plumage a glossy black, having a greenish shade in the sun. The female—head and beak neat and of moderate size; eyes bright, comb single, very large and pendulous; face entirely white, which extends round the eye; neck of moderate length, neatly set on; body broad, wings of middle size, legs almost white, tail long and well squared; plumage as in the male, but less brilliant."*

7. THE BANTAM FOWL.

These little, consequential fowls are considered to belong originally to the Eastern Archipelago, and to have sprung from the wild Bankiva fowl of Java. These latter are thus described by Mr. E. Hewett, residing near Birmingham:—"The opportunity was once afforded me of narrowly watching the habits of a pair of Bankiva fowls, originally from Java, but which their owner had obtained from a dealer in Portugal. The male in appearance was closely assimilated to the black-breasted red Bantam, though in one peculiarity differing greatly from that bird, his tail being always, whether quiescent or otherwise, carried almost in a straight line with the back. The same was the case with the female; and, beyond their somewhat slighter form, this appeared to be the only distinguishable difference between her and the hen of the domestic variety. These birds were, unfortunately, extremely wild, and confinement seemed to effect no change whatever on their natural habits. The hen, indeed, laid a few eggs, which were at once devoured by the parents. In fact, so unsociable and pugnacious were they, that, although attempts were made again and again to cross them with the black-breasted red Bantam, death to the new comers invariably ensued. Even the hen killed a very resolute little fellow of that variety, when placed, after nightfall, side by side on the roost with her alone. They would not fight during the presence of any one, but the instant they saw the coast clear, they set to most determinedly; and, if not over-matched in size, with invariable success. Their end, however, was a melancholy one, for a game hen placed with them, employed her greater strength for the destruction of both."†

The writers of the "Poultry Book," appear to consider the restless disposition of the Bankiva wild bird as decisive against the supposition that the Bantam derived its descent from it. This, however, is inconsistent with the history of the origin of domestic animals in general, and with that of the Bantam in particular. That bird is still notorious for its pugnacious disposition, and we know what the influence of domestication has on all animals. If the Bankiva fowls mentioned above were taken when full grown, which is probable, it will at once account for the impossibility of taming them, or of inducing them to associate with the domestic fowls. We have found this to be invariably the case when old birds from the wild, have been put with others of the tame breed—that the former always beat the latter. Whatever other variations may exist between them, may be accounted for by domestic treatment, crossing, and the influence of climate. The idea of others that the Bantam is the diminutive of the larger breeds is

* "Poultry Book," p. 107. † Ibid., p. 191.

quite as opposed to the history of birds. As well might the partridge be considered a degenerated pheasant, or the quail the diminutive of the partridge. Degeneracy in size implies the loss of the finer qualities, such as courage, &c.; but there is not a more courageous bird in existence than the male Bantam; and we have known one of the breed to beat a dunghill cock of twice his bulk and strength.

But whatever may have been the origin of the Bantam fowls, there is no dispute as to the perfection and beauty of their form and plumage, and in these respects they are certainly miniatures of the most beautiful of the larger breeds—as the Hamburghs, the Polanders, the Game fowl, &c. The varieties are comprehended under the following list:—

The Nankin Bantam.	The Partridge Bantam.
The Game ,,	The Black ,,
The Spangled ,,	The White ,,
The Seabright ,,	

All these varieties are reputed to be excellent layers, sitters, and mothers. The eggs, of course, are small, weighing about 1 ounce, or $1\frac{1}{4}$ ounce. Four or five eggs a week, of a white or pale buff colour, during the season of eight months is not an uncommon produce. The chickens at first are very small, and require to be kept perfectly dry and under shelter for some days after being hatched, and to be fed with chopped egg, meat, hemp-seed, and bread soaked in beer. The hen is indefatigable in attention to her offspring, and will resolutely defend them from all enemies. In other respects the Bantam is rather a fancy bird than a useful one; yet when dressed *as game* its flesh is highly and finely flavoured, and the numerous broods a Bantam will rear without difficulty is no mean recommendation to keep it, as an interesting variety, in the poultry yard.

8. THE FRIZZLED FOWL.

It is hardly possible to believe that this bird is a really distinct breed, with its disorderly plumage, giving the idea of its having been repeatedly drawn by its legs backwards through a thorn hedge. Yet there appears no reason to doubt that it is found in a wild state in Ceylon, being called by the native Cingalese, *Capriltakullo*. It is, however, rare, and is said to have been brought thither from Batavia. It is now found in Java, Sumatra, and all the Philippine Islands.

They are generally white when in the wild state, but some are variegated with black and brown. Some of them have smooth, and others feathered legs. The beak of the cock is hooked; the hackle is tinged yellow; the comb is cupped and serrated; the ear-lobe white, the entire body feathers white in the wild breed and curved backward; the tail is full and well sickled; legs blueish, height eighteen inches, weight $5\frac{1}{2}$ lbs. The hen is entirely white, and the feathers are curled back like those of the cock. The head is small and sharp, height twelve inches, weight $4\frac{1}{2}$ lbs. They are bad layers, but capital sitters and mothers, and are recommended for hatching the eggs of pheasants and other game birds. They are excellent, though small, for the table.

9. THE SILK FOWL.

"Hens that instead of feathers have hair like cats," is the quaint description given by old travellers and writers of this singular bird, albeit, it is somewhat of an exaggeration.

The web of the feathers is long and fine, and being each distinct, they have the appearance of hair rather than of common feathers. They were once considered to be natives of India, but are now found to belong to China, Malacca, and Singapore, from which places they have been exported to India, and from thence to Europe.

These birds are generally white with a black skin. The surface of the bones, also, is covered with a black pigment. The tail feathers should resemble fine gauze. In form they are round, compact, and long on the legs. There are, however, some varieties differing in many particulars from this description, one of which has a white instead of a black skin, while the plumage is the same.

10. THE SHANGHAE, OR COCHIN CHINESE FOWLS.

The introduction of this singular breed of fowls into the United Kingdom, and the long time that the "mania" (as it is called) to be possessed of them has lasted, is one of the most singular instances of popular fancy on record, and is not to be accounted for on any of those grounds on which such manifestations of public favour are usually based. Possessing, as we do, numerous breeds of poultry of the most beautiful form and plumage, and, in addition, all the qualities to render them useful and desirable as well as ornamental, the only sound and sensible motive for adopting a new one, we might suppose, would be superiority in beauty or excellence of qualities. With regard to the Cochin Chinas, none but the most enthusiastic amateurs, or the fortunate dealers who reap so large a profit from them, will claim for them the palm of beauty, or pretend to set them in competition, on that score, with any one of the other breeds of British poultry. Let us say once for all, on this head, and without any prejudice, that in regard to personal appearance, we have from the first considered this breed below mediocrity; in fact, frightfully ugly.* And this impression was much strengthened when its alarming "crow" burst upon our ears, so utterly unlike the short, sprightly, and cheerful note of our own chanticleer. The only ground, therefore, on which the popularity of the Cochin Chinas can be permanently justified or sustained, is, the possession of those qualities which render them more useful than other breeds. As our object is to make the reader acquainted with the real merits or demerits of the domestic animals of which we write, we shall examine the grounds on which the Cochin China or Shanghae breed of fowls has been forced into notice, and what reason there is to suppose it will permanently enjoy the favour of the public.

Not satisfied with passing an opinion resting solely upon our own judgment, we have taken considerable pains to inquire into the subject from those who are more practically acquainted with this breed of fowls than ourselves; and the result has convinced us that, although in some respects the Cochin Chinas may be considered an acquisition, there are defects in them, which, coupled with the absence of that beauty of form and plumage, by which the other breeds of British poultry are so pre-eminently distinguished, lead us to believe that when the "mania" has subsided, and the breed is more generally disseminated and tested, it will hold only a secondary position amongst its compeers. That they are the "giants of the poultry yard," no one will dispute. But *size*, as a test of

* Upon a first view of these strange creatures, we could think of nothing to compare them with more appropriate than the Hottentot Venus of other days in huge knickerbockers, or a modern French dandy in his pinched up hat and crinolined trousers.

merit in *any* of the domestic animals, has long been discarded from the creed of the British farmer,* it being generally counterbalanced by peculiarities fatal to the claim.

Taking the good qualities of the Cochin Chinas first, we may mention that they are good layers, close and careful sitters, excellent parents, of quiet and sociable dispositions, and they bear confinement better than any other breed. These particulars we shall examine as we have stated them.

The Cochin China fowls begin to lay at five months, and are frequently known to lay two eggs a day; but in that case there is generally an intermediate day without an egg. Some instances have occurred in which *three* eggs a day have been dropped; but as in these cases one of them has invariably been a *lush-egg* (that, is, destitute of a shell), the circumstance may be attributed to disease or accident. However this may be, it is certain that the pullets, beginning to lay at five months, will continue to lay nearly all through the winter. Mr. Punchard sold a six months' pullet, which laid a buff egg the next day, and in the following 116 days laid 105 more eggs, the first ninety-five being laid in ninety-six days.† Generally, they continue until they have deposited from thirty to forty, when they show a disposition to sit. But some have laid as many as seventy or more before they became "broody," as in the case mentioned above. As many as 240 eggs have been taken from one fowl in the year; but it is remarkable that the eggs are much smaller than those of any of the other breeds, except the Bantams; so that taking weight for weight, it is probable that the Dorking, Spanish, or Polish breeds, or even the common Barn-door fowl will produce as much in weight as the Cochin Chinas. The great advantage, therefore, that these latter hold out is, their laying throughout those months of the year when eggs (fresh laid), are scarce and dear. Whether they are really richer in quality than other eggs, to make up for the deficiency in size and weight, does not appear to have been clearly ascertained. The weight is generally from 2 to 2½ ounces, very few indeed ever exceeding the latter.

They begin to sit early, and continue very close. There were some exhibited at Birmingham in December, 1853, *whose grandmothers were hatched early in the same year*. The desire of incubation appears to be remarkably strong in them; so much so, indeed, as to cause great annoyance to their owners, who sometimes resort to the most barbarous practices in order to break them of it, but to no other purpose than to shorten their lives. When once they have determined to have a brood they will continue to sit even when the eggs are taken from them and the nest destroyed. The "Poultry Book" has some very sensible remarks on this subject:—"We do not believe that this provision of nature can be frequently set aside without injury to the bird. Her due batch of eggs having been completed, a period of rest to the whole system, and its productive powers in particular, is now designed. This we disregard when we refuse to allow the hen to sit; and as she will again commence laying long before the period she would have done had she been allowed to hatch and rear her chickens, she is unduly stimulated, and a drain is caused on her constitution, which evidently affects her at last. Occasionally, when we want eggs, or it happens at an improper time of the year, such as the end of autumn or winter, we should not, of course, allow her to gratify her inclination. But with such

* The late Earl of Leicester took great pains to inculcate this truth. We have before observed that one of the standing toasts at the Holkham sheep-shearing dinners was "small in size and great in value," which was always given by the Holkham chieftain himself.

† The "Poultry Book."

fowls as manifest this desire, we should consider that one brood of chickens at least, in each year, is necessary to keep them in health and vigour."*

When the Cochin China hen has commenced sitting she seldom leaves the nest more than once a day, and her food should be ready for her at a certain hour, as she seldom deviates from her usual time. She seldom remains off more than half an hour, and frequently not so long, unless she has to seek her food because none is provided for her. Some hens will never willingly leave the nest, and are obliged to be lifted off, it being supposed necessary for the welfare of the expected brood, that fresh air should be admitted to the eggs once a day. The shell of the egg is porous, and allows the air to pass through it. When an egg is heated, owing to the expansion of the interior, a portion of the air is driven off. When the egg cools down, as is the case when the hen leaves the hatching nest, a corresponding contraction takes place, and fresh air must enter the egg to supply the place of that which was expelled.†

As parents the Cochin Chinas are exemplary, and no family of young children can be better attended while they behave themselves properly, but if, while under a coop herself, she sees them run into all manner of dangers, her agitation is extreme; and when by her recall she has gathered them again round her, she is apt to chastise them too severely for their erratic disposition, no doubt forgetting for the time her own peccadilloes in the same way. Many breeders, if a hen hatches only five or six chickens, put them to another with a small brood, and if this is done judiciously the step-mother will adopt them without any objection. The night after hatching is the best period to take this step, for if done after the hen has left the nest, it is doubtful whether she will put up with the fraud (for such it certainly is) which she may resent by breaking the skulls of the intruders. The young mother is apt to be too fussy, and to trample on her chicks while hatching, and must therefore be watched, and the chicks taken from her, as they are emancipated from their confinement.

The quiet and sociable disposition of the Cochin Chinas is beyond dispute. They will allow themselves to be handled without signs of fear, and wander but little from their accustomed haunts; nor do they suffer from close confinement, some of the best fowls ever exhibited having been reared in garrets and cottages, where they could have little exercise for their limbs. We do not put this forward as an example to be followed, because all domestic animals are better for, and require, exercise to keep them in continued health. We may add to the foregoing recommendations that they are a hardy breed, and can bear the vicissitudes of heat and cold, at least, as well as any other of our English fowls. "They bear," says the *Cottage Gardener*, "a Canadian winter even better than our common fowls." This is a strong point in their favour in a northern climate, although in our comparatively temperate one it is of less importance.

* The "Poultry Book," p. 74.

† The necessity, however, for this accession of fresh air to the egg is by no means a settled question; and, from experiments recently made, it would appear to be quite the contrary. "An egg," says Mr. Couch, of Penzance, "just laid, was covered over with albumen and allowed to dry. Then slips of parchment soaked in albumen were laid over the egg, and allowed to dry. This was done four times, taking care never to suffer the edges of two layers to come together, and all allowed to dry. On the fourth day after it was laid, it was put, thus covered, under a hen. Several were thus served. Result:—Embryo developed as on ordinary occasions, to the fourteenth day. . . . . In subsequent experiments, with the same precautions, the chick arrived at perfection, but could not escape."—(The "Poultry Book," p. 81.) In Rees' Encyclopædia, also, the question is treated as more than doubtful. Haller states that "the air does not pass into the egg for the purpose of effecting any change in the blood of the fœtal chick similar to the process of respiration, as has been supposed." There is no process analagous to respiration in the fœtus.—Rees' Encyc., Article, Incubation.

We must now inquire what drawbacks exist in these fowls to neutralise or detract from the merit of their good qualities; and it is necessary to bear in mind that it is not the production of eggs and chickens *alone* in extra profusion, that will render them valuable as a permanent addition to our list of domestic animals. What then is the quality of the flesh of the Cochin Chinas as compared with that of other breeds, and at what cost are they reared?

With respect to the first there is a difference of opinion existing which, without taking into consideration the position of those who have publicly expressed themselves upon it, can scarcely be appreciated. We shall again quote from the "Poultry Book" (p. 26). "The profits hitherto made by a few successful breeders have been enormous, because they have been fortunate enough to possess excellent specimens of a breed now in great request, but this cannot be depended upon; their real utility is still matter of argument, or rather, I should say, their superiority over other breeds. As they become spread over the length and breadth of the land their value must decrease; or if very large prices are still made, they will belong only to those choice specimens which are always exceptional. What is to become of the mass of birds which while they are useful are not the *élite* of their class? They must contribute food either by furnishing the table with poultry or eggs. In those parts so distant from the metropolitan market that the cost of carriage, and in very hot weather the time employed in the journey, renders it doubtful whether a certain profit may be depended upon from poultry killed and sent up, the supply of eggs will be thought preferable. The question then naturally arises which is the most profitable breed to keep? The answer must be that which produces the greatest number of eggs at the smallest cost. The Pencilled Hamburgh," the writer adds, "would be his choice for this purpose." The Editor quotes the above from a letter of a large breeder; he adds, "Our own opinion would be different; but when he asks for a definition of the best fowl for the table, our hearty assent is at once given to that which fats best at an early age, at the least expense, and which possesses those properties most valued for food."

A writer in the *Cottage Gardener*, on the same subject, says, "They have short legs well feathered, small bone, beautiful white flesh, quite equal in that respect to the Dorking; they fatten fast—in short, I think they possess all the good qualities of the Dorking as well as the Cochin China."

Again, Anster Bonn, a fancier, says, "We have eaten a great number of Cochin China fowls, and find them, without exception, by far the finest flavoured, best birds for the table which we have ever bought, bred, or eaten. A consideration most valuable to the poor man, and to those who have his interest at heart, is the indifference of Cochin Chinas to first-rate accommodation. They are very robust and healthy, seldom ill, and less easily hurt from the egg-shell upwards than most kinds." Another writer in the *Cottage Gardener* says, "The Cochin Chinas do not eat more in proportion to size than the Spanish or Dorkings; they fatten rapidly, and the short-legged variety lay on much flesh on the breast and wings."

Having thus given the evidence in their favour we must turn to the other side of the question; and when we state the following opinion as that of Mr. Bailey, a considerable breeder, and one of the most respectable poulterers in the metropolis, its weight in the scale will be duly appreciated. "In spite of all that may be said, the Cochin China fowl, however desirable as a layer, on table produces much offal meat. My experience leads me to think that the Cochin Chinas are very profitable so long as there is a demand for them at large prices for stock; but when that ceases, and they have to compete with other breeds as purveyors for the table, they will sink below the Dorkings, and rank with the many other second-class breeds. Remarks have been made in praise of their giblets, but these, properly speaking, belong to a goose. They comprise head, neck, pinions, feet, gizzard, heart, and liver (a fowl has none in this country). In Paris the *abatis* comprises the same parts of a turkey or fowl. Now the most *recherché* part of a fowl is the breast, and that is the point on which the Cochin China is deficient, and what she lacks there she makes up in giblets."*

In the new edition of "Moubray" by Messrs. Meal and Horner, we find the following remarks:—"At table the Shanghaes are ungainly, and the quantity of offal on the neck, legs, &c., the comparative leanness of the breast, and rather pheasant-like or gamey flavour of the flesh (sometimes loose, dark, coarse, and stringy), render them undesirable for that purpose, while the uninviting colour of the skin precludes their appearance as a boiled dish. On this point much diversity of opinion exists, as some high authorities assure us that a roasted Shanghae is most juicy, short, and delicious eating. Individual high feeding and superior breeding does produce fowls with flesh both white, and tender, and delicate; and it is, therefore, difficult to say what care and attention in these respects may be able to accomplish."

On the above opinions we shall only remark that those in favour of the Cochin Chinas were given at the time when the "mania" was at its highest, and prejudice ran almost exclusively on that side of the question; while the last two opinions were given after twelve or fourteen years' experience, and by men the best qualified to judge both correctly and impartially. By this time, however, the public at large will be able to form their own judgment upon it, as the wide dispersion of the breed throughout the country will now take them out of the category of a speculative, and place them in that of a purely commercial breed, where they will soon find their level.

With regard to the expense of keeping and fattening the Shanghaes there is a wide difference in the calculations of different breeders, even to 50 per cent. or more. Thus, while some have pretended to fatten them at the rate of three halfpence per week, others, charging the same price for the food, have not been able to keep them on less than from threepence halfpenny to fourpence halfpenny. On the other hand, the author of the "Poultry Book," who kept a large quantity of various ages, found that the average expense was twopence per week the year round; but this did not include the time when they were fattening; and this opinion is confirmed by Mr. Bowman, who was also a considerable breeder. It certainly is a very low average for so large a fowl, but it must be recollected that those at liberty were able to supply themselves with a great part of their food.

The following is the description given by Bailey of the Shanghae, or Cochin China, fowls:—"The cock should have an upright comb, with correct and numerous serrations; ample hackles and saddle; gradual slant from the head to the centre of the back, and rising thence to the tail; very fluffy thighs and hinder parts; bright eyes, and long ear and wattles; very level tail, and made up of numerous small curly feathers that seem to roll over the back, rather than to stand up as in other birds; legs feathered to the toes; wings tightly clapped up; upright carriage. The hen should have a sharp,

* Bailey, "Fowls, a Plain and Familiar Treatise," &c.

intelligent head, comb small, scrupulously straight, and full of well-defined serrations. Thighs and hinder parts entirely hidden in soft silky fluff; short legs feathered to the toes; short, thick-looking necks; head carried rather forward than upright; there should be a gradual rising of feathers from the middle of the back to the top of the tail, which should end in a black, round point."

The colours vary considerably, and are buff, lemon, cinnamon, grouse, partridge, white, and black. The greatest defect in their personal appearance is the deficiency of sickle feathers in the tail, and the clumsy fluffiness in the thighs and hinder parts. Their wings, also, are very small in proportion to the size of the bird, and are not calculated either for the shortest flight, or even for sustaining the weight of the body; consequently, if placed upon a high perch, their descent from it is rather a tumble than a jump assisted by the wings, as with other fowls. Consequently, they are frequently injured if placed in such positions, and require a very low perch for safety. The roosting-poles should, therefore, be not more than two feet from the ground. If you want to possess a pure type of the breed, you must avoid buying long tails, clean legs, fifth toes, and double combs. Sickle feathers in the tail the true Cochin Chinas never have.

There is no question that the Shanghaes are the best adapted of any breed to a confined situation, and that they suffer less from a want of fresh air than any others. Where they have been judiciously and systematically attended to, some of the finest and healthiest birds have been reared where it is impossible for them to obtain any range beyond a small court, or even a small room in a cottage. This, to a poor man, is an inestimable advantage, many of that class, however desirous of keeping fowls, finding it impossible to preserve them in tolerable health for want of room. In this respect, therefore, the Shanghae is essentially a poor man's fowl, and many of the prize birds have been reared in cottages. But whether even these could be made to pay a profit when the "mania" has subsided, and prices have settled down to their legitimate level, is a question yet to be decided. Under such circumstances they must be kept wholly upon artificial or purchased food; and if it cost the owner of the fowl 4*d.* per week, as in the case of "Gallus," and only the maximum of 240 eggs per season obtained, if these are reckoned at 9*d.* per dozen, which is as much as could be reckoned upon, there would be a loss of 2*s.* 4*d.* each fowl, besides the keep of the cock, which would be a non-producer; and as to keeping them as breeding fowls, it would be still more unprofitable, as the progress they make in fattening, according to "Gallus," is too small to cover the expense.

It is quite another thing where persons who keep fowls have a good piece of pasture or a barn-yard for them to run in. In the former case they will more than half keep themselves on worms, slugs, grass, &c., and in the latter there is always plenty of "shack" for fowls left in the straw, to support them until they are cooped for fattening. But a Polish or Hamburgh fowl will do quite as well, and require less keep, because they are not so large as the Shanghae; and it is idle to say that a large fowl can be kept on as little, or less, as some persons would make us believe, than a small one. We do not think that the experiments of amateurs, or professed breeders for sale, ought to be a rule for the farmer who intends making a commercial affair of poultry. Hitherto the Shanghaes have been chiefly in the hands of the first of these; and with the certain stimulus of enormous prices, no expense or efforts have been spared to produce fowls of the first quality, and to increase the production of eggs. Under such a system wonderful results have certainly been obtained; but when the same fowls are subjected to the ordinary mode of living in the farm-yard, we much question whether they will maintain that position amongst other breeds, which the fanciers have hitherto assigned to them.

With respect to the fact of the Shanghae fowls laying twice, and even three times in the same day, the author of the "Poultry Book," while admitting the truth of it, appears to consider it exceptional; and the instances he adduces are followed by intervening days in which none were deposited, at least, this was generally the case. In one instance there was a remarkable deviation from this rule. "At the close of last autumn," says the relator, "one of my children was presented with a pair of Cochin Chinas, male and female, bred by a clergyman in Kent. They were hatched late in spring, and, in November, two eggs were found one morning in the nest, supposed at the time to be the produce of two days. However, upon the next day there was one, and the day after two. One day then elapsed and two eggs were again laid, and so on to the present time, when she continues to present her young mistress with five eggs every four days, which, for so long a period, is very unusual. It is a remarkable fact, that upon the days the hen lays two eggs, unless closely watched, the cock and she lay claim to one of them, which they invariably consume, leaving the other untouched which is the case when a single egg is laid." The editor adds:—"Such instances ar extremely rare; and under no circumstances can it be considered as the habit o property of those, or, indeed, of any other race of fowls."*

The Shanghae chickens are longer in becoming fledged than other fowls. When first hatched they are covered with a thick coating of down, which gives them the appearance of being much larger than they really are, or than the size of the egg would warrant. Notwithstanding this they grow rapidly, and arrive at maturity earlier than other fowls. If they are well fed and taken care of, they are hardy, and will stand the wet and cold better than most breeds.

11. THE RUMPLESS FOWL.

This very singular breed appears to be a variety of the Cochin China fowl, from whence, according to Mr. Layard, it has been introduced to Ceylon, where it is called *Choci-Kukullo*, which literally means Cochin fowls. Certainly, in other respects than their destitution of the posterior ornamentation, they very much resemble the Cochins in their fluffy appearance, and small wings and head, but not in their size, as they seldom exceed sixteen inches in stature, and $5\frac{1}{2}$ lbs. in weight. There are no peculiarly valuable qualities about them to induce a farmer to keep them except as curiosities, being neither ornamental nor useful.

12. THE BARN-DOOR FOWL.

This designation includes all fowls of no particular breed, being the offspring of crossings with all other breeds. They are of all colours, and may be said to represent in one or other of their peculiarities all other breeds, without having a claim to identification with any. Some of them are exceedingly beautiful, and if properly cultivated and attended to, might certainly originate new and valuable varieties. They are very hardy, require

* "Poultry Book," p. 63.

no particular care, and they yield their quota of eggs and chickens, and support themselves at far less expense of time, labour, and money, than the more fashionable poultry. They are, however, considered but as a plebeian race, and the ignominious epithet of "Dunghill fowl" is the general title by which they are vulgarly known. Yet many of the cocks betray affinity to the Game, Polish, and other fowls, by the splendour of their plumage; and the hens are sometimes equally distinguished by the intermixture of rich colours. We much question, also, whether the more approved breeds, if left to themselves like the Barn-door fowl, would either cut a more respectable figure, or yield so good a profit to their owner; whilst their cheapness brings them within the reach of the cottager, by whom they are generally kept in considerable numbers, and to whose families they afford a seasonable relief.

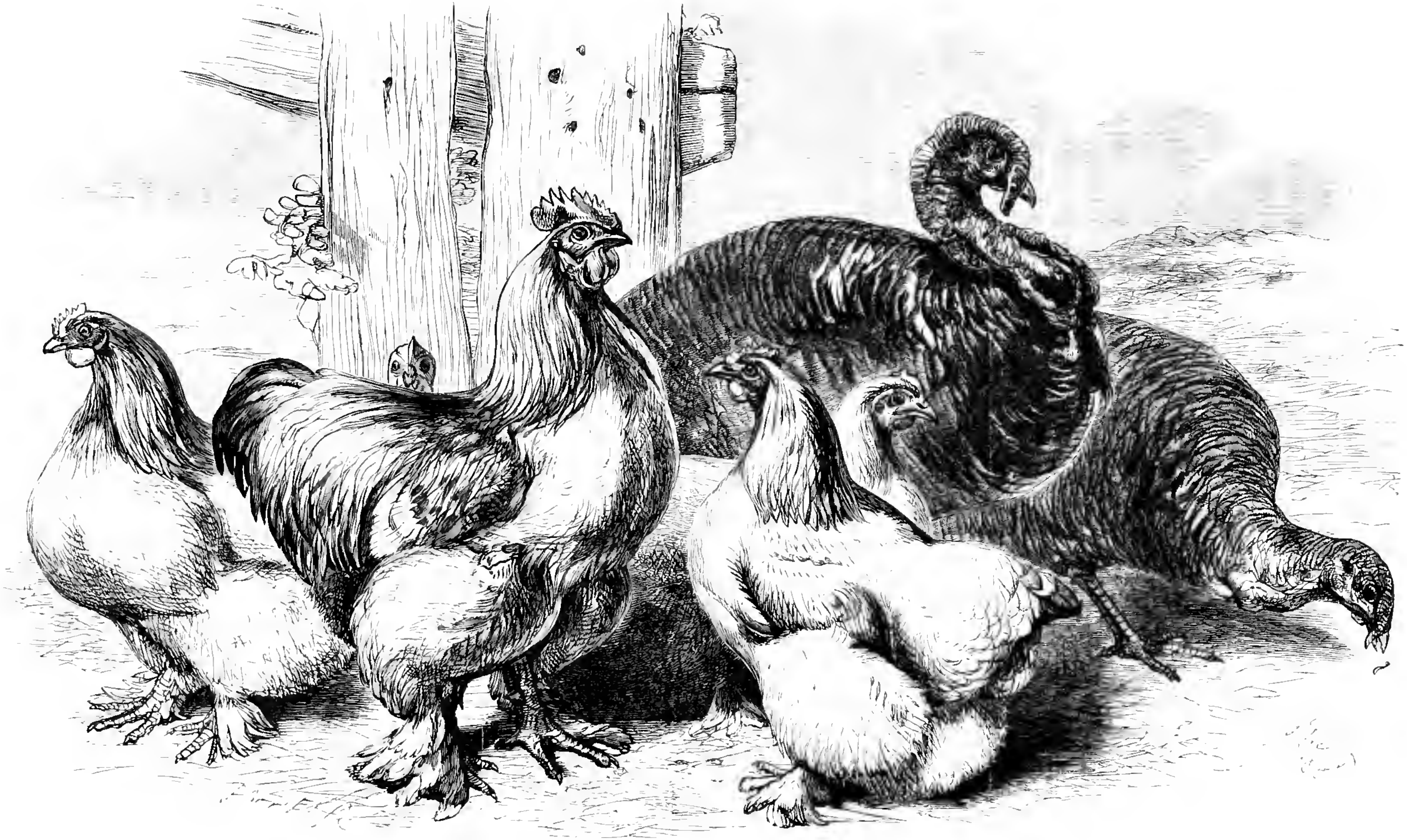
13. THE TURKEY.

All writers on poultry agree in assigning to the forests and prairies of the New World the honour of furnishing the Old with this most useful bird. It still exists in a wild state in the woods of Alabama, Arkansas, Indiana, Illinois, Louisiana, and others of the central and western states of the American Union. It was the first discoverers of that continent by whom the Turkey was first imported into this country about the year 1540 or 1550: for Sir Anthony Fitzherbert does not name it amongst his list of domestic poultry in his "Book of Husbandrie," which was published in 1532; whilst Tusser, in his "Five Hundred Points of Good Husbandry," which was published in 1573, mentions it as a standard part of the Christmas bill of fare, which it has maintained ever since:—

> "Good bread and good drink, a good fire in the hall,
> Brown pudding and souse, and good mustard withall;
> Beef, mutton, and pork, shred pies of the best,
> Pig, veal, goose, and capon, and *Turkey* well drest,
> Cheese, apples, and nuts, jolly carols to hear,
> As then in the country is counted good cheer."

There is also a tradition in the family of Sir George Strickland, Bart., of Baynton, Yorkshire, that one of their ancestors brought the first Turkey to England. William Strickland went out with Sebastian Cabot on his voyage of discovery to the New World, in consequence of which Edward VI. granted him "a coat of arms with the crest of a Turkey cock in his pride, proper." Barnaby Googe also, in his "Four Books on Husbandry," writing on the breeding of fowls in 1578, says, "Turkey cocks we have not had long among us, for before the year of our Lord, 1530, they were not seen with us, nor, I believe, known to the old writers." He then goes on to describe them just as we see them at the present day, in their appearance and habits, and speaks of the number kept at the residence of "that godly and virtuous Sempronia, that Lady Hales, of Kent, who was first the wife of Sir Walter Mauntill, of Northamptonshire."

From what cause it was called a *Turkey Cock* no allusion to it by the ancient writers gives any explanation. The only probable conjecture is, that the red comb and long wattles of the bird, and its dark plumage, resembled in some degree the *fez* cap and flowing robe of the Mussulman. The wild Turkey, as the progenitor of our present fowl, is thus described in the "Poultry Book:"—



COCHINS AND TURKEYS.

"The wild cock Turkey has its head covered with a blueish skin, which extends over the upper part of the neck. This skin is wrinkled and drawn into wart-like elevations, which change colour to red on their upper portions, and to white below. A few black bristly hairs are scattered over this skin, which extends in front of the neck into large pendulous, almost pouch-like wattles, a wrinkled, conical, fleshy protuberance, capable of elongation, and with a pencil of hairs at the tip, takes its rise from the upper mandible of the beak. When this excrescence is elongated under excitement, it covers the beak, and depends several inches below it. Beak reddish, but brownish and horn-like at the tip; iris of the eye dark brown; a tuft of long, bristly hair grows from the lower part of the neck at its junction with the breast, attaining a length in full-grown specimens of nine inches. The base of the feathers of the body, which are long and square tipped, is covered with a light greyish down; this down is succeeded by a dusky portion, which is followed by a broad shining metallic band, varying in colour from copper or bronze to violet or purple; and the tip of the feathers is a broad, dark, velvety band, but this band is absent from the feathers of the neck and breast. The general plumage presents a glancing metallic lustre, which, however, is least glossy on the lower part of the back and tail coverts. The wings are concave and rounded, not extending much, if at all, beyond the base of the tail; quills, in number twenty-eight, the primaries being blackish, banded with white, and the secondaries whitish, banded with very dark grey, and tinged, towards the back particularly, with brownish yellow. Tail fifteen inches in length at the least, rounded at the end. Its feathers, eighteen in number, broad, and capable of expansion and elevation into the form of a fan. These tail feathers are of a brown ground colour, mottled with black, and crossed with numerous narrow, wavy, black lines. There is a broad black band near the tip, then a short mottled portion, and lastly a broad, dingy, yellowish band. Legs robust and red, their scales having blackish margins; spurs about an inch long and blunt; claws dusky; length nearly four feet; expanse across expanded wings more than five feet. The average weight is from 15 lbs. to 18 lbs., but instances have occurred of their weighing 36 lbs. The Prince of Musignano (Charles Buonaparte) places the weights higher, stating 20 lbs. as the minimum, and 40 lbs. as the maximum." *

The wild Turkey hen differs from the cock in having more slender beak and legs, the latter destitute of spurs; less naked skin about the head and neck, smaller wattles at the base of the beak, and a less brilliant plumage; and the length not more than three feet and a quarter, and the weight from 14 lbs. to 20 lbs.

How the county of Norfolk came to be the "land of Turkeys," *par excellence*, it is impossible to say; but certainly more are bred in that county than in any other, and it supplies London with a large proportion of those consumed at Christmas. In this respect, however, Cambridgeshire contributes a large quota of very fine birds. The "Poultry Book" states that one London dealer goes down to a certain district in this county, and sees to the slaughtering and packing of 1,800 Turkeys the week before Christmas. There are several varieties of the Turkey, as the Black, or Norfolk, the Cambridge, or Bustard breed, the White, the Tufted White, the American. The chief difference is in the White and the American. The White is considered an accidental variety, as the young ones of a white mother are frequently dark birds. The Americans have a more brilliant plumage than either of the English breeds, and will probably be

* "Poultry Book," p. 63.

employed to infuse fresh blood into them. The weight of the tame or domestic Turkey when fat varies from 18 lbs. to 30 lbs. in the cocks, and from 14 lbs. to 20 lbs. the hens. They seldom exceed the maximum of 30 lbs., excepting the Stag Turkey, or over-year birds, which are sometimes fattened up to an enormous weight for particular purposes.

The Turkey chick is a very tender animal, and for the first few weeks requires great care and attention. The hens will nurture two broods in the season, and may be kept for that purpose four years; but it is recommended by some of the largest breeders to change the cocks every year, and never to employ one more than one year old. The hen, if brought up near the house, is a very domestic fowl, and will seldom roam farther than the first pasture or orchard if she is accustomed to be fed at home. After harvest, however, it is the custom in Norfolk to let them have the run of the cleared barley fields, to "shack in," as it is termed, preparatory to being put up to fatten for Christmas. They lay only every second or third day, and do not produce more than from thirteen to twenty eggs before they show a disposition to sit. The first seven or eight eggs are sometimes put at once under a common hen, in order to have them hatched as early as possible. The Turkey may be left to undertake the charge of the rest, as she can cover thirteen eggs very well. The best time for hatching is from the last week in March to the last week in April. The second brood is of little value, and very difficult to rear, as, indeed, are the early ones. If exposed to cold or damp at night the first few weeks after hatching, they contract the cramp, which soon kills them. A covered place for the coop is therefore absolutely necessary at night, and also in the daytime when the weather is wet or cold.

After two months, with proper care, they will be able, in a great measure, to shift for themselves, being tolerably fledged. When many are kept, they are usually turned out to forage in a clover stubble or pasture, under the care of a lad or a girl, who prevents them from straying too far from home. They do not acquire their full plumage until three months old, at which period they require almost as much care to keep them from damp as in the first month. It is necessary at all stages to feed them well twice or three times a day, according to the quantity of food they can obtain for themselves. This should be continued till they are fat, which will be about Christmas time. They are then either consumed in the family, sent as presents to friends, or sold to the poulterers. A large number of them, however, are sent in droves, after shacking the barley and oat stubbles, to London and other large towns, where, in their half fat state, they are sold to persons who have the convenience for finishing them off for the market. These generally consist of the later hatched birds, and they usually sell at from 3*s.* 6*d.* to 5*s.* each, according to size, but they do not fatten up to any great weight—say from 7 lbs. to 10 lbs. or 12 lbs.

The breeders of Turkeys never keep a cock bird for breeding longer than its second season, and six hens are considered a proper number for each male. The cottagers in Cambridgeshire and Norfolk who keep Turkeys for breeding, send their hens to a neighbouring farm where a cock bird is kept, and thus save themselves the expense of keeping one, which would materially lessen their profits.

The cramp is a disease that young Turkeys are exceedingly liable to, but it may be avoided by keeping them dry and warm, and giving them proper food. Although now acclimatised with us, it is still an exotic bird, the native of a less variable climate, where the breeding season is more equally warm than with us. The young birds, therefore, being too tender to withstand the vicissitudes of our summer, must be carefully protected against cold and wet; whilst their food for the first month should be of the most nourishing and generous kind, such as hard boiled egg chopped fine, bread crumbs, hemp-seed bruised, oatmeal or barley-meal, all mixed together, adding mustard and cress or some other warming vegetable, and the whole softened with milk or water. The coop should be placed in a sheltered situation with a southern aspect, but shaded from the perpendicular rays of the sun at noon, while fully exposed to it the rest of the day. Damp and cold, however, are the greatest enemies of the Turkey chick, and cannot be too sedulously guarded against, until they are three or four months old, when, having become fully fledged, they are better able to withstand the changes of temperature.

Food should be given to Turkeys in troughs with a railing before them, sufficiently open to admit the head and neck, but nothing more. This will prevent them from trampling on and otherwise destroying their food, which they would otherwise certainly do. Many of the birds get fat in the barley stubbles, especially when the weather has caused the grain to be shed more than usual; but even in this case it is better to give them a month's fattening at home, after they have cleared the field of loose grain, as their continued growing will more than repay the expense, besides having them in higher condition for the market. For the farmer's own table, a fowl killed off the "shack" is fat enough, and has a higher flavour than one that has been regularly fattened in the coop. In all cases, plenty of clear spring water is an essential ingredient in their diet; and in a dry time when at "shack" water troughs should be set in the field for them, or they should be driven to a pond, if there is one at hand, several times a day, to quench their thirst.

14. THE PEA FOWL.

"Gold and silver, apes and peacocks," were parts of the treasures brought to King Solomon by the ships from "Tarshish," or "from beyond seas." The Pea fowl is a native of India beyond any controversy, for the ancient authors of Greece and Rome speak frequently of it as brought from thence and from Persia. By the Romans they were classed with the common domestic fowls, and Columella gives ample instructions for their management. It was by the Romans that this splendid bird became diffused over every country in Europe where their conquests were carried; and in Britain it has been known from the earliest period of history. At present, however, it is a rare bird with us, being chiefly kept in the parks of the nobility and gentry, or at the old granges and manor houses distributed throughout the country. The farmers, in fact, are no friends to them, on account of their destructive propensities in the corn-fields; but especially in the gardens, where, in a few minutes, as we have experienced, their depredations and mischievous scratchings on the seed-beds render the prospects of a crop more than doubtful. The Italians say "the peacock has the plumage of an angel, the voice of a devil, and the peculativeness of a thief."

"Fine feathers, however, make fine birds;" and certainly nothing adds more to the interest and aristocratic bearing of an old rural mansion, than the sight of two or three of these magnificent birds strutting about in all the pride of their gorgeous plumage, their fan-like trains shining like burnished gold in the sun's rays, with all the colours of the rainbow beautifully and systematically blended together; whilst the fine symmetry of the rest of the form, and the upright and majestic tread of the creatures, show their consciousness of superiority of personal appearance over every other denizen of the *basse-cour*.

Like the Turkey, the Pea fowl is an exotic, and has never so far been acclimatised with us, as to overcome that delicacy of constitution, which, in the earlier stages of its existence, makes it so susceptible of the sudden alternations of heat and cold, wet and dry weather. Unless protected for many weeks after hatching, they can scarcely be reared. The Pea hen lays usually not more than from four to seven eggs of a yellowish white. They sit from twenty-eight to thirty days, and when hatched the hen should at once be cooped in a safe place away from the cock bird, who will sometimes destroy the young chicks if he can get near them. They require the same treatment as the Turkey chicks, and must not be let run at large until they are at least six weeks or two months old. They generally do not lay until two years old, unless they are themselves very early birds. Their nests are formed with little regard to warmth or security; a few weeds and dry leaves collected under the low spreading branch of an evergreen, constitutes all the preparation they make for the important business of incubation, during which, however, they are very jealous of being disturbed. They are for this reason frequently hatched under a Turkey hen, which makes an excellent step-mother, and can be better managed than the Pea hen.

The Pea fowls are very good eating, and formerly were generally kept for the table. In the middle ages a feast or entertainment was not considered complete without the presence of a Pea fowl roasted and afterwards sewed up in the skin, with the feathers rearranged as when alive, and the comb gilded, the whole served up as the last course. It is generally supposed that the disuse of the Pea fowl as a favourite dish, is to be ascribed to its being superseded by the Turkey as having a superior flavour; but the writers of the "Poultry Book" correct this error, and assert that the Pea fowl is not at all inferior in flavour, and that the neglect into which it has fallen arises rather from its destructive propensities in the field and the garden, and the difficulty with which the few chicks it produces are reared: these are the real causes that so few Pea fowls are now kept by the farmers, who find the balance of profit or loss always on the wrong side, taking all things into account.

15. THE GUINEA FOWL.

The classical name of this bird is *Numidia meleagris*, but it is also called the Pearl Hen, on account of the white spots in its plumage, the *Pintado*, by the Spaniards, and the *Gallina* by the Italians. The name by which it is commonly designated here indicates that it was introduced from the west coast of Africa or the Guinea coast. It was known, however, by the ancient Romans, and is described by both Columella and Varro as being reared by the Roman farmers at the beginning of the Christian era, having been brought from Africa during the wars of the Romans with that country; and it is supposed that it was brought to Britain by Cæsar's legions at the time, or after the conquest. However this may be, it appears from ancient records that the monks kept them in the thirteenth century, calling them *Aves Africanæ*, or African birds.*

* Amongst our peasantry they are called "come backs," from the call of the hen much resembling those words. This, in fact, is the principal mark by which to know the female from the male, so much is the plumage alike.

The Guinea hen is a prolific layer, but being fond of roving away and concealing her nest in grass or corn-fields, it is difficult to discover it. The eggs are very rich flavoured, but as the birds *pair* like tame pigeons, unless there is a male to each female, the eggs of the single hen will prove abortive. The flesh is excellent, and furnishes an important substitute for game, after the season for the latter is over. The cock birds are quite as good the second year as the first; and it is usual to fatten them for the table, and fill up their place with young birds. They generally sell at a good price when killed, but the keepers of poultry seldom make them an object of speculation, probably on account of their roving and destructive habits in corn-fields and gardens. If not pinioned they fly over the highest fences as well as a pheasant. Attempts have been made to keep them wild in the plantations, but in the northern and eastern districts of England they have invariably died in the winter; and in the south they drove away every other description of game, and the owners were obliged to destroy them in order to preserve the rest. The following is the description of this fowl in the "Poultry Book":—

"The beak is short, stout, slightly curved, and whitish, having a warted bluish red membrane at its base; wattles fleshy and scarlet; eye black, prominent, and bright; eyebrow very distinctly marked and arched; head and neck covered with downy feathers like those of the Silk fowl; forehead surmounted by a long *Casque;* tail short and bending inwards as in the quail and partridge; legs blue, with a tinge in places of a flesh colour; plumage grey or leaden, spangled with white spots, varying in size from that of a pea to infinite minuteness. The weight of the male very slightly exceeds that of the female; and, indeed, we have known hens outweigh the cocks of the same brood. The weight varies from 3 lbs. to $4\frac{1}{2}$ lbs." *

The varieties of this fowl extend no farther than the colour of the plumage. The Netted Guinea fowl has the marks of the feathers so curiously arranged as to give the bird the appearance of being covered with network. The Self-coloured Guinea fowl has the hackle and back a leaden grey, without any spots on those parts. The White Guinea fowl is white all over, except the legs, which are yellow. The Pied Guinea fowl has usually the neck, breast, and belly white, and the rest of the usual colour. Hybrids have been produced between the Guinea hen and the common Barn-door cock, but they are monstrosities, and in every instance barren and of doubtful sex.†

The Guinea fowl is strongly attached to the place of its birth, and if sold away from it when grown up, will assuredly find its way back to it. The only way, therefore, of setting a stock of them, is either to purchase eggs, and put them to be hatched under a common hen, or young chicks to be brought up by hand. No treatment, however gentle or liberal as to food, will tame the full grown birds. But those reared on the premises will, of course, become attached to it, and when full grown will couple of themselves, if there is an equal number of each sex. They should be fed regularly at evening, in which case, wherever they may have roamed during the day, they will return home as night approaches, and roost in an outhouse in winter or on a tree in summer. They are not adapted to bear the severity of the former season.

The favourite food of the Guinea fowl is buck-wheat; but it is as well to give them a good proportion of animal food in the winter. When well kept and allowed their liberty, they lay from fifteen to thirty eggs before they show a disposition to sit. They

* "Poultry Book," p. 252. † Ibid.

are very close sitters, and will sometimes bring off as many chicks as they have eggs, to the surprise of the owner, who has probably been unable to discover their nest, so secret are they in this important affair of incubation. When hatched, the young chicks should be placed under a coop, in a warm, dry situation, where the sun's rays are freely admitted. They should be fed and treated much the same as the young Pea fowls; but their food should be given them in small quantities at a time, and very frequently. They require to have access to places where they can procure plenty of insect food, of which they, in common with other fowls, are very fond. It is asserted by poultry keepers, that if the young Pintado is kept without food three hours, it will inevitably die. It is therefore necessary to keep them constantly supplied with fresh food of a nourishing kind until they are able to forage for themselves, when they may take their chance with the other fowls, being fed only morning and evening. This will be at the end of six weeks or two months, provided the weather is fine and warm; otherwise they must still be kept under shelter. The chicks are beautiful little creatures when first hatched, with their red beaks and legs, and brown striped silky down backs. They are as lively as crickets, which adds much to their interest; but they very soon assume a shyness which is the characteristic disposition of the breed. If allowed full liberty they will soon stray away. They never associate with other fowls, but keep themselves quite distinct, and form what is called "a pack of Guinea fowls." The latest time for hatching them is from the end of April to the beginning of June.

Guinea fowl are in season from February to the end of May. They are considered as game, and as such, require to be hung up some days before cooking; when dressed as the pheasant they are quite equal to that bird in flavour. They are, however, considered by the gourmands at their best for the table *before* Christmas; but as game at that period is plentiful, the Pintado is not much in request until the season for the former is over.

16. THE SWAN.

Although this can scarcely be called a farm-yard fowl, it is frequently kept by gentlemen having a small park with a lake, or a stream of water running through it. The time has been when no one was allowed to keep swans without a royal licence, and this was only granted to the possessor of land. Thus, in the reign of Edward IV. the privilege was limited to freeholders of land to the clear value of 5 marks (£3 6*s.* 8*d.*), the only persons exempt from this law being the king's sons. In Elizabeth's time there were 900 individuals and companies, or corporate bodies, who held "swan marks," some of which were very curious. Thus the Vintners' Company marked their swans with a notch, or nick, on each side the beak, from which circumstance was derived the sign of the "Swan with Two Nicks," since altered to "*two necks*," a gross blunder, which a slight reference to the records of the company might have rectified. The Lord Mayor and corporation of London still keep up the annual custom of "*Swan-hopping*" on the Thames, where a great number of swans are constantly to be seen in going up and down the stream. The institution is for the purpose of marking the young swans that have been hatched in the season.

The Mayor and corporation of Norwich also still retain the privilege of keeping swans on the Yare and Wentsum; and a swan-herd is amongst the functionaries in their employ, whose duty is to attend to and protect the swans on the city streams. Mr. Yarrell, on the authority of Dr. Stanley, the late Bishop of Norwich, relates the following custom as still observed in that city by the corporation. On the second Monday in August the cygnets of that year, whether in charge of the city herdsman, or belonging to members of the corporation and private persons, are collected together to the number of fifty or sixty on one stream, where they are supplied with all the barley their rather voracious appetites can possibly dispose of; and in about three months they are considered sufficiently fattened for the table, when they are returned to their respective owners, accompanied by a copy of the following poetical directions for their treatment in the kitchen—directions, by the way, so business-like as to merit a place in the next edition of Soyer's cookery book:—

"TO ROAST A SWAN.

"Take three pounds of beef, beat fine in a mortar,
Put it into a swan—that is, when you have caught her;
Some pepper, salt, mace, some nutmeg, an onion,
Will heighten the flavour in gourmands' opinion.
Then tie it up tight with a small piece of tape,
That the gravy and other things may not escape.
A meal paste, rather stiff, should be laid on the breast,
And some whited brown paper should cover the rest.
Fifteen minutes at least ere the swan you take down,
Pull the paste off the bird, that the breast may get brown.

"THE GRAVY.

"To a gravy of beef, good and strong, I opine,
You'll be right if you add half a pint of port wine.
Pour this through the swan—yes, quite through the belly,
Then serve the whole up with some hot currant jelly.

"*N.B.—The swan must not be skinned.*"

The Hooper or Wild swan is a native of the northern climes, and visits the United Kingdom only when the winter is very severe; they then come over in considerable numbers, and are found in the estuaries and unfrozen parts of rivers. They are very shy birds, and must be approached with great caution. In flight they generally go in pairs, and present a beautiful object as they sail at a great height, their snow-white plumage glittering in the sun like silver. They are not easily killed, and will carry away a good deal of shot, unless struck in a vital part.* Their skins are very valuable on account of the down which covers them under the plumage, but the flesh is rancid and fishy, which, in fact, is the case with the tame swan when not put up for fattening. The writer once shot a cygnet in the winter of the previous spring-hatching, and when it was cooked the odour from it, much more the flavour, was too strong to bear it in the room.

The Black swan, the *rara avis* of Pliny and other ancient naturalists, was for a long time considered an imaginary bird, until the discovery of the Australian continent, where it was found to be a native. How the Romans became acquainted with it is quite a mystery, but as these large and strong winged birds take long flights, it is very

* A friend of the writer's was once shooting sparrows and other small birds, when a Hooper appeared in sight, about thirty or forty yards high above the earth. Without any anticipation of even wounding it, he fired his charge of sparrow shot at it, and, to his amazement, the bird's head dropped, and it fell almost at his feet, dead. On examination, he found that a *single shot* had pierced the lower mandible, and passed through the roof of the mouth into the brain, causing instant death.

possible that individual birds may have been blown over from Australia in a storm from the southward, and, by way of the African continent, found their way to the south of Europe. They are a much slenderer bird than the European swan.

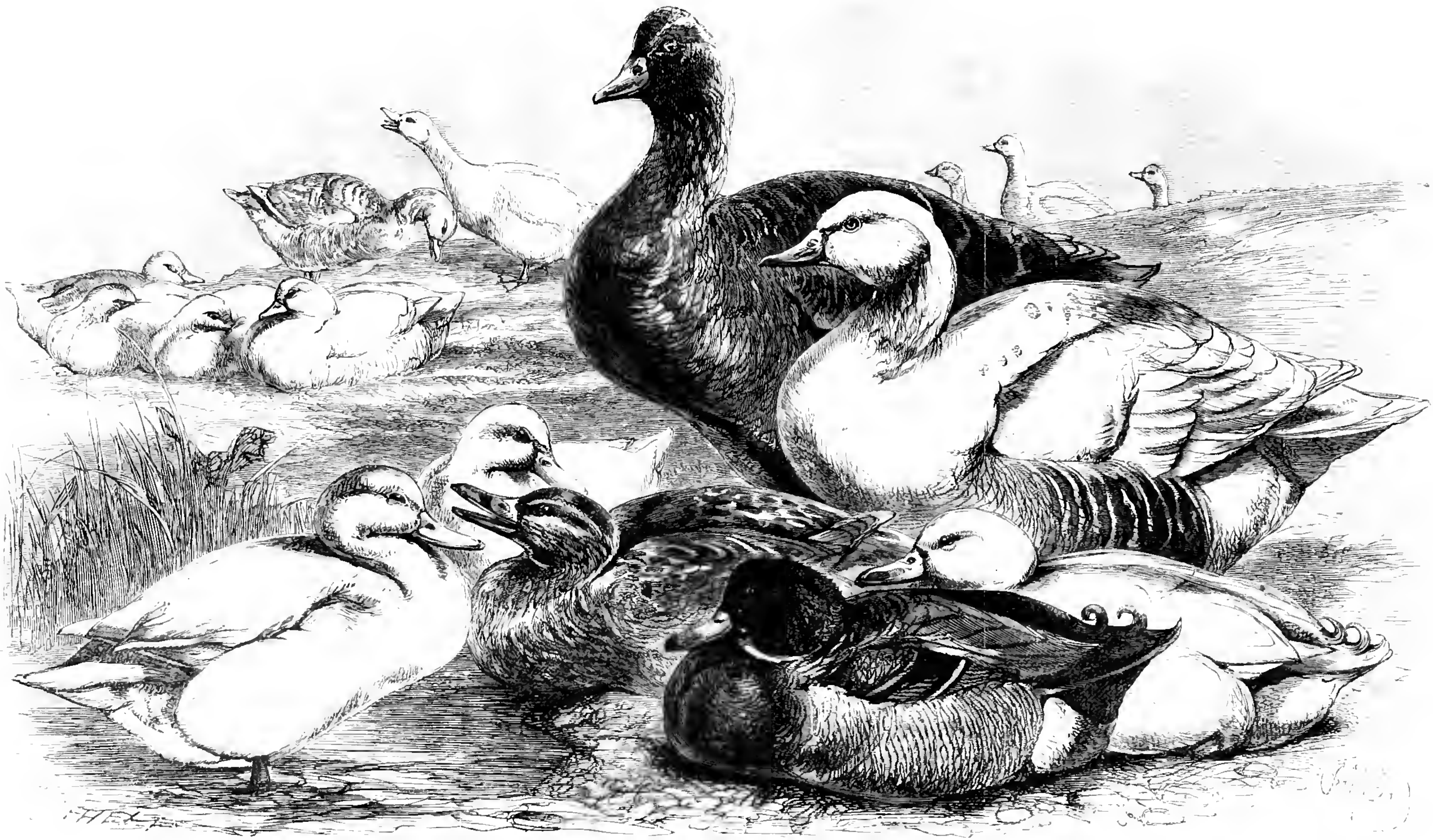
The domestic swans lay from five to eight eggs, and sit thirty-two days. Their nests are very large, and are generally built in a shallow, rushy part of a stream, or on an island in a lake. Both the male and female birds are very sedulous and fierce during the incubation in guarding the nest from intruders, and will master and drown any dog that dares to attack them, by holding him under water with their powerful pinions and bill. The swans always go in pairs, a male and female. They live to a great age, and it is a vulgar notion that they always sing melodiously when they are about to die. This is a very ancient superstition.

17. THE GOOSE.

There are three wild varieties that claim to be the parent of the domestic goose—the *Anser ferus*, or Grey-legged; *Anser albifrons*, or White-fronted; and the *Anser segetum*, or Bean goose. In order, however, to satisfy all parties, it has been suggested that probably all three had a share in the paternity; and a fourth auxiliary has been added of late years in the *Anser phœnicopus*, or Pink-legged goose. The dispute, however, is not so easily settled; and as the controversy would lead us astray from our design, having stated the case, we shall leave the reader to follow it up, and proceed to describe the peculiarities of the domestic fowl as bearing upon the profits of the farm-yard.

The "Poultry Book" enumerates three sub-varieties of the English goose, namely, the Grey or White goose, with both colours blended in different proportions; the large White Embden goose, sometimes called "the Irish goose;" and the Toulouse Goose. Of these the first has constituted the general stock of the country, and but little attention has been paid to its improvement by the infusion of fresh blood, although both the Embden and the Toulouse birds have been long imported, and are of a much larger size. The colour of the Embden is perfectly white, which renders its feathers of more value than those of the common kind. The Toulouse goose is noted for the retention of certain fixed colours in its plumage, with which no cross has hitherto interfered; and for the large size to which it will fatten. The colours are darker and more intense than those of the common Grey goose, and the bill, legs, and the circle round the eye are of a bright orange hue. One merit attached to these birds is, that although fatting up to a greater weight than any other breed of European geese, they do not become so gross as to be uneatable, as some others are, when brought to table.

Three varieties of the goose have been introduced into this country from China of late years, namely, the Red-legged, the Black-legged, and the White Chinese goose. Of these the last is the most valuable and attractive, both on account of its large size and its swan-like appearance. The bill and feet are bright yellow, and the wings are too weak for flight. They are prolific layers, and their period for incubation extends to five weeks. The goslings are easily reared in the spring, but the autumnal hatching is seldom successful, though the hen bird continues to deposit a batch of eggs for that purpose. The breed, however, has not made any way amongst those who make the rearing of geese for market a business, the old native bird being still the universal



WHITE AYLESBURY DUCK. TOULOUSE GOOSE ROUEN DUCK. EMDEN GOOSE.

DUCKS AND GEESE.

dependence of the breeders, occasionally crossed with the Toulouse variety, when a gander of that breed can be obtained.

The county of Lincoln is the most noted for rearing geese, and the metropolis is chiefly supplied from thence with those birds. Large establishments are kept up for that purpose, at some of which many quarters of corn are daily consumed by them whilst brooding. At the farmstead of Monk's Dyke, in 1850, there were consumed weekly during the season one hundred quarters of barley or oats, 3,210 geese being the number fed daily. In Norfolk, also, where there are still extensive commons and marshes, a great number of geese are reared by the cottagers, and sold to the neighbouring farmers at harvest time to take the "shack" of the barley stubbles, being afterwards disposed of to the dealers. One of these, Mr. Bradshaw, of Norwich, has extensive grounds for feeding and preparing fowls of all kinds for market, where he has generally 2,000 geese besides other birds. Many of them are imported from Holland and Belgium.

The goose is a bird easily reared, and is but little trouble. Three or four geese to one gander is considered the utmost number. The older the breeding geese are the more chance there is of success, the eggs of the yearling being seldom certain of production. Some breeders go so far as to limit the number of geese to each gander to two. The goose is a long-lived bird, and she continues to breed to the last. We have heard of geese seventy years old, but from twenty-five to thirty years is by no means an uncommon age at which to see them leading about a numerous brood at the door of a cottage bordering on a common or a marsh in Norfolk. The "Poultry Book" mentions an instance of a goose kept by a farmer near Andover, twenty-three years old, which had never failed to rear two broods every year, her second hatch in 1853 being ten healthy goslings.

Plenty of water and grass are the essential requisites for rearing geese. They are, however, a decided nuisance in a pasture with horses and other animals; but when a pasture has been eaten down by these, the geese will then devour the tufts of coarse grass that the horse or sheep have rejected. But the best feeding ground for the broods of geese is an extensive common, with a pond of water accessible, to which they can constantly resort unmolested. With a boy or girl to overlook and take care of them, they have no rural enemies to fear, nor will they roam far from home, to which they return as the day declines. The cottage goose breeder puts up with such accommodation for the bird, during incubation, as his scanty premises will allow. But with the farmer, who makes the rearing of geese an object of farming profit, it is necessary that an adequate provision of accommodation should be made, where they will be protected from the intrusion of destructive animals, such as weasels, polecats, rats, foxes, &c. While the broods are young, they should be watched continually during the day, to prevent these vermin from destroying them; and every crevice in the walls of their sleeping place must be stopped to prevent the enemy from entering. A few handfuls of oats, morning and evening, are sufficient for the young birds, when they have plenty of grass and water.

The goose usually lays from twelve to fifteen eggs before she shows a disposition to sit; but it sometimes exceeds that number, especially the Toulouse variety, some of which have been known to lay as many as from forty to fifty eggs before attempting to sit. The end of March and the beginning of April are considered the best months for the commencement of incubation in the north of England, but in the southern and milder counties they should be hatched in April, if not in March. The later hatched goslings are difficult to rear, and seldom reach the size of the early ones. When the brood goose lays more eggs than she can fairly sit on, which is the case with the Toulouse variety, as they are too valuable to be consumed as eggs, they should be put under a duck of one of the large breeds, or to a Shanghae hen, who makes an excellent stepmother. The duck, however, is preferable for the office, on account of her aquatic habits being more in accordance with those of the expected progeny.

The custom of plucking live geese twice a year is still practised in Ireland and in some parts of Lincolnshire; but it has been found that this barbarous practice is no gain to the owners of the birds, as it prevents them from fattening and attaining the weight they would otherwise reach, nor do they appear so well at table as those who have escaped the barbarity. The author of the "Poultry Book" suggests that now that all other animals are protected from cruelty by act of parliament, "plucking geese alive" ought surely to be a misdemeanour, punishable by fine or imprisonment.

The wild goose is a "bird of passage," and formerly, when extensive marshes covered a large part of England, vast numbers of these birds annually arrived, especially on the occurrence of a severe winter, when the estuaries and inland lakes were almost covered with them and other wild fowl. At present their visits are few and far between, and they limit their presence generally to the estuaries, where great numbers of them are annually shot. They frequently are in the habit of assembling at nightfall on the extensive fields of the large farms in West Norfolk and Lincolnshire, where they nibble down the green blade of the wheat, till they leave the field as bare as a fallow. It has, however, been found that so far from injuring the plant, it rather benefits it, so that in the spring it shoots forth with greater vigour, and more numerous tillers. Like other wild fowl in flight, they always form a mathematical figure, which they maintain with great exactness, and generally very high in the air, except at night, when their flight is not more than fifty or sixty feet from the earth, and sometimes much less. They never associate with the tame birds on any occasion. Their residence during summer is considered to be within the arctic circle, where they can rear their young, unmolested by the presence of man.

18. THE DOMESTIC DUCK.

It is the general opinion that this bird derives its origin from the wild duck and mallard; and this is confirmed by the experiments that have been made to cross them with the wild breeds, which has generally succeeded. Whatever difference may appear in the colour of their plumage or their feet, those of the wild duck being black, may be accounted for without destroying the identity in other respects. In fact, there is as great a difference amongst the wild, in these respects, as there is with the tame breeds. The teal, the sheil fowl, and the mallard, are quite as dissimilar as the White Aylesbury and the Buenos duck; and it is not improbable that crosses between such of the wild breeds as may have been caught and domesticated, have originated those varieties which we now see amongst the tame breeds.

It is alleged against this theory, that where the eggs of the wild duck have been hatched by a tame or domestic bird, whether duck or hen, as soon as they become full fledged, they take wing and fly away. There is no doubt that the constant flight of the wild duck gives it a power on the wing far beyond that of the domestic bird; and that this power becomes hereditary in the egg, whether hatched by the parent, or under a tame bird, is also clear. The fact, therefore, of the young birds availing themselves of their strength of wing is no argument in favour of their being a distinct species. It will require many generations of tame breeding to reduce this power of flight; and the inclination to exercise it is common to both the wild and the domestic bird, only that the latter is enfeebled by higher living, and consequently a greater weight of body, as well as by the want of exercise for the wings.

The question, however, is of little importance in any other point of view than as a fact of natural history; and we shall, therefore, leave the naturalists to settle it, if it is capable of being settled, in the best way they can. It is the opinion of many amateur poultry breeders, that our present domestic duck was imported from India and China about the period of the discovery of the passage to the East by the Cape of Good Hope (1493). Tame ducks, however, are mentioned in history two centuries before that period as kept in England. Dugdale, in a list of prices of provisions in 1290, gives the value of a duck at 1*d.*; and in an act of the common council of London for regulating the value of poultry, about the same period, the price of a mallard was fixed at 1½*d.* Chaucer also speaks of both ducks and drakes in a manner denoting that he was well acquainted with their habits. However this may be, the most approved varieties now in the United Kingdom are as follows:—

1. The Rouen Duck.
2. The Aylesbury Duck.
3. The Buenos Ayrean Duck.
4. The Common Farm-yard Duck.
5. The Musk, or Brazilian Duck.

1. The Rouen, or Rhone Duck.—This, as the name indicates, is a bird of French origin, and is considered by some persons as the most profitable variety. The plumage is rich, especially of the drake; it lays a great number of large eggs, and the flesh is considered finely flavoured. It is a remarkable feature of this bird's character, that it shows no desire of incubation until it has done laying for the season. An instance is mentioned in the "Poultry Book," of three of these birds having, from February to July, laid 334 eggs, five double eggs, and several "lush," or soft ones; and one of them laid ninety-two consecutive days, without evincing a desire to sit. They attain a great weight when fattened, and have been fed up to from 6 lbs. to 8 lbs. weight each. They are dull, lethargic birds, and seldom stray far from home. The following is a description of them given in the "Poultry Book," p. 289:—

"Drake.—Bill inclined to green; the nail and around the nostril black; head and neck, as far as the white collar, which should be very distinct, brilliant iridescent green; throat and breast claret brown; back, scapulas, and thigh, grey, with minute wavy dark lines at right angles to the shaft of the feather; tail brown, with the outer edge of the feathers white, forming a broad margin of that colour, the three centre feathers being curled; primaries brown; secondaries with a bar of bright steel blue forming the speculum, then a band of black, the extremities being tipped with white; lesser wing-coverts rich brown; greater wing-coverts the same, with a narrow white margin; under part of the body grey, with the same wavy dotted lines as on the back; legs and feet orange."

"The duck has a uniform plumage of rich brown, every feather being more or less marked with black. Bill, legs, and feet dusky. Irides light brown in both sexes."

2. The Aylesbury Duck.—This bird is distinguished by an unspotted white plumage, a pale flesh-coloured bill, a dark, prominent eye, and orange legs. It derives its name from the town of Aylesbury, in Buckinghamshire, on account of the great numbers reared and fattened there and in the neighbourhood for the supply of the metropolis. The Aylesbury ducks fatten up to 10 lbs. to 12 lbs. the pair, but some of them will reach 8 lbs. or 9 lbs. each, if well fed. They are great layers, and have been known to deposit as many as 150 eggs in one year. They consume less in fattening than any other breed, and are remarkably quiet and silent. They are close sitters, and generally bring off two broods in the season, if the first is hatched early. Thirteen or fourteen eggs is quite a sufficient number for this bird to cover properly, and the fresher these are the better. The time of incubation is from twenty-six to thirty days.

The Aylesbury ducks, when fattening, are not allowed to be at liberty, and are forbidden to have access to water for the purpose of swimming, although for drinking a full allowance is necessary.

3. The Buenos Ayrean, or Black East Indian Duck.—This is a smaller breed than either of the two former, not fattening to a greater weight than 4 lbs. to 5 lbs. live weight. It is, therefore, rather a fancy bird than an object of profit, and the exceeding splendour of its plumage renders it an ornament to the poultry yard; and this beauty of plumage is shared by the duck as well as the drake. The groundwork is an uniform velvet black, with iridescent metallic tints, varying with the light from green to a gilded purple, the whole exhibiting a singularly close, neat, compact arrangement of the feathers, of the most brilliant combination of colour. Although these birds are not profitable, they possess the quality of a fine flavour, and are much esteemed for the table. For an ornamental water on a lawn or in a park, they are particularly suitable, and will always be favourites on account of the beauty of their appearance.

4. The Common Farm-yard Duck.—This, like the Barn-door fowl, is of no particular breed, but exhibits in the variety of its plumage, the crossings, undefined, to which it has, in the course of years, been subjected. They are of all colours and all sizes; while some will not weigh more than 4 lbs. or 5 lbs. when fat, others will reach 8 lbs. at eight months old when well fed. They do not generally stray far from home, unless it is in the vicinity of a river, when the freedom of that favourite element sometimes tempts them to wander further. They are not so good layers, generally, as the Rouen or Aylesbury ducks, but they are excellent sitters, and sometimes lay and sit in the winter. The writer, when a boy, once found a nest of fourteen eggs with the duck sitting closely on them, which were hatched on Christmas Day. He took charge of them himself; and although it proved a severe winter, they were all saved under a common coop, covered over at night, and protected from the cold wind by day.

Where ducks have free access to a common with a pond of water, or a marsh, it costs but little to rear them, for they are quite able to forage for themselves. If a corn-field is near the homestead, they are by no means scrupulous about the doctrine of *meum* and *tuum*, but will make their way into it under a gate or through a hedge. They are voracious feeders; and in all cases, if dependent upon artificial means for a livelihood, they will soon wear out the patience of their owners by "eating their heads off," as it is termed.

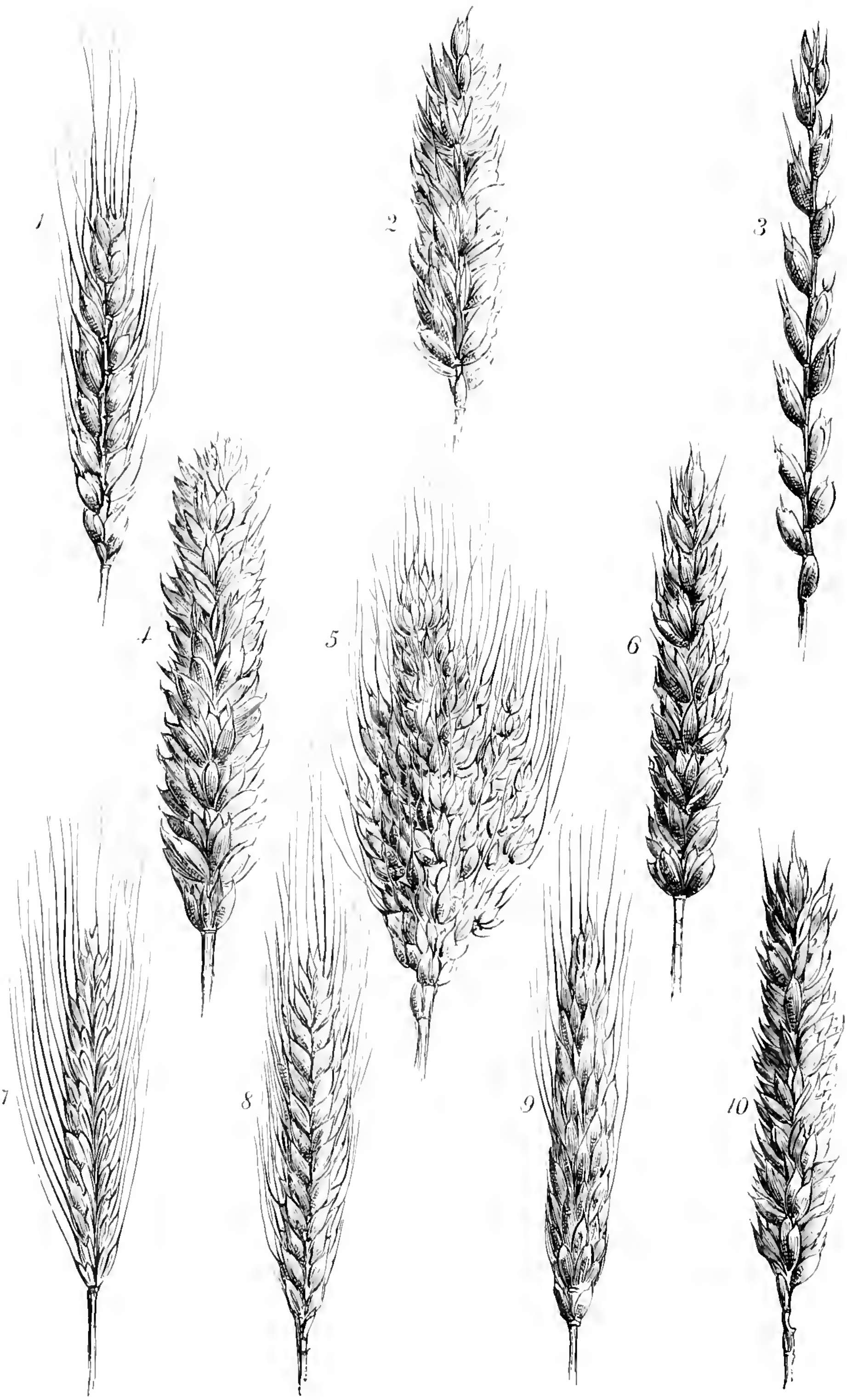
5. The Brazilian, or Musk Duck.—This bird is considered to belong to a distinct species, having several peculiar characteristics differing from those of any other breed. One of these is the disproportion in size between the male and the female, for while the latter seldom exceeds 5 lbs. or 6 lbs., the former frequently attains to 9 lbs. or 10 lbs. in weight. The colour varies from black to white, with a mixture of brown or drab. When domesticated, the plumage assumes brighter and more varied colours, and the legs and feet are mottled flesh-colour and black. At the base of the bill is an excrescence of red flesh, which gives it an ugly appearance; and the skin round the eyes is of the same colour. They differ from all other ducks in roosting on the branch of a tree, or on a stone wall. The term Musk duck is given to it from the idea that the plumage emits the odour of musk; and from this circumstance it has been called the "Muscovy duck," although it has never been seen in European Russia.

They are very inferior, as layers, to either the Aylesbury or the Rouen, and are not at all before the Farm-yard duck. The eggs are of a dusky white, weighing about three ounces, and the period of incubation is five weeks. They are great tyrants in the poultry yard, and will bully their weaker neighbours: and as the flavour of the flesh is questionable at least, although extolled by some amateurs, their ugly and ungainly appearance leaves little to recommend them to the favour of the farmer.

PART V.—THE VEGETABLE KINGDOM.

Cultivated vegetables are agriculturally divided into two classes, viz., those directly employed in the sustentation of man, and those consumed by the animals on which he preys or feeds. The most important and essential of the plants of the first class are termed *Cerealia,* from *Ceres,* the heathen goddess of harvest, they being cultivated for the sake of the seeds they produce, which constitute the harvest. The *Cerealia,* again, are divided into corn plants, and leguminous plants. The former, capable of being profitably cultivated in the United Kingdom, are wheat, rye, barley, oats, and possibly maize; the leguminous plants are beans, peas, kidney beans, and, rarely, lentils.

The corn-plants are termed "the cereal grasses," because they all belong to the gramineous tribe of plants. They are rightly considered to be annuals, for if allowed to mature their seeds the first season, they invariably die; and, although from experiments, intentional or accidental, there is reason to think that if maturity of seeding is prevented by cutting down the flowering stem of the plant repeatedly, the existence of any of the cereal grasses might be prolonged beyond the first, if not the second, season, as no perceptible advantage would be derived from the process, we may rest content to consider them as annuals, commencing and terminating their existence within the agricultural season or year. Beginning, therefore, with the corn plants, we shall first treat of that which, in this country at least, is constituted and designated "the staff of life."



1. APRIL WHEAT. 2. HUNTER'S. 3. TALAVERA. 4. SPALDING'S PROLIFIC. 5. COMPOSITUM. 6. RED, OR LAMMAS. 7. ONE-SEEDED. 8. POLISH. 9. SPELT. 10. CHIDDAM.

SECTION I.

WHEAT—ITS HISTORY.

A GREAT deal of learned argument has been employed, and, we cannot help thinking, thrown away, respecting the origin of this cereal; and that the naturalists, in endeavouring to discover what is totally beyond their range of investigation, have lost sight of, or ignored the fact, that the existence of wheat *in its present form*, can be distinctly traced back for nearly four thousand years. And if we further consider that at that early and remote period of the world's history, agriculture, which was the first occupation of man, was probably confined to the simple cultivation of such seeds and plants as presented themselves to his notice, in a form calculated to afford him sustenance, we may reasonably conclude that a production so essential to the well-being of the human race, was created in the form best adapted to use; and that although cultivation may have, and, as we know, has, produced modifications of the plant, in different countries and climates, yet, that it has always existed as a farinaceous grain, capable of being at once converted, by mechanical means and processes, into a nutritious and wholesome food.

Two remarkable experiments, made during the last seventy years, have given sanction to the supposition that wheat derives its origin from a diminutive grass-seed, of the species *Triticoides*, called *Ægilops ovata*, or *Triaristata*, which is found in great abundance in Sicily and the south of France. The first of these experiments was made by the late Sir Joseph Banks, who, having in the year 1805, received from a lady a packet of grass-seeds labelled "*Hill wheat*," planted them in his garden. They were the size of our wild grass-seeds; but, on being examined with a microscope, they were found to exhibit all the outward form and appearance of wheat. To the astonishment of Sir Joseph, the produce of the first year was *perfect wheat*, resembling in size, as well as in every other respect, the spring wheat commonly grown in this country. The account of these seeds simply stated that they came from India; but every inquiry of Sir Joseph respecting the precise part of that extensive country they came from proved fruitless. He conjectured that they were obtained from the high grounds at the back of the plains of Bengal, or from some other of the mountainous regions of the Indian peninsula. On the other hand, Baron Humboldt, who is no mean authority in such matters, supposed that they were brought from the mountains of Boutan, an island in the Indian Ocean, about twelve miles from that of Celebes; and that it would, perhaps, prove to be the primitive type of the *Solanum*, or cultivated cereal.

The second experiment was made by M. Fabre, a celebrated living French naturalist. On examining the seeds of the *Triticoides*, or *Ægilops ovata*, with the microscope, he found that, like the "hill wheat" of Sir Joseph Banks, they had all the appearance of wheat, except in their size, which is very small. He carefully cultivated them in his garden, under his own inspection, for *twelve consecutive years*; and, in the end, he also obtained perfect wheat, differing but little from the common spring wheat usually cultivated in the south of France.

These two instances of the effects of cultivation have given rise to, or confirmed, the foregone conclusion, that wheat was originally nothing more than a diminutive grass-seed improved by cultivation; and that the *Triticoides*, to which both the "hill wheat," and the species employed by M. Fabre, appear to belong, is the actual parent of all the varieties of the *Triticum* family of plants now existing. Before, however, this is conceded as a probable theorem, it must be proved that the reverse is not the case, and that the *Triticoides* is not rather a degenerated type of the true *Triticum*, the vestige of an abandoned cultivation, reduced by neglect and deterioration of soil to its present state of degradation. We daily see the effect of imperfect cultivation on the size and quality of seeds; and there is nearly as much difference between the best types of the wheat of western Europe, and the small hard wheat of the Steppes of Russian Tartary, where Nature is almost left to herself, as there is between this latter and the *Ægilops ovata* of Sicily and the south of France, or the "hill wheat" of India.

Independent of this, the historical evidence, both in the sacred and profane writings is inferentially in favour of the opinion that wheat, in its most useful form, was an original plant, created as such for the benefit of man, and to constitute a chief portion of his food. The promise given to Noah after the Deluge, that "seed-time and harvest should not cease,"* implies the cultivation of such plants as wheat and barley. One hundred years after the death of Noah, Abraham directed Sarah, his wife, to prepare "three measures of fine meal, to make cakes upon the hearth" for the strangers who visited him.† Sixty-four years after the death of Abraham, mention is incidentally made of "wheat-harvest,"‡ which, whilst it establishes the fact that that grain was then cultivated, renders it probable that in the two previous cases its use was implied as a portion of the food of the patriarchs. As we proceed in the sacred narrative, the evidence of the existence and cultivation of wheat in its present form accumulates. The seven-eared corn produced in Egypt, during the seven plentiful years foretold by Joseph, was the exact prototype of the present Egyptian wheat (*Triticum compositum*) which still produces from three to seven, and even eleven ears on one stalk, according to the season, as in the time of Joseph. Specimens of this wheat are found in the mummy-cases, which have probably been entombed for three or four thousand years. There is, we believe, no doubt of the truth of this, although it is denied by some that the species termed "mummy wheat" now extensively cultivated, was actually the product of that which was so discovered. There is, however, nothing inconsistent with the nature of things in wheat, thus protected, preserving its vitality for any number of years. The cere-cloth and preparations of the mummy would hermetically seal the wheat from the atmosphere, and so preserve it in its original state; and, besides this, the air of Egypt is so free from moisture, as to possess an antiseptic property, in itself favourable to the preservation of grain and seeds.

In profane history, wheat is referred to by the earliest writers extant. Ceres, the goddess of harvest, was a native of Sicily, and introduced the art of agriculture at Athens in the year 1409, before the Christian era, according to the Arundel marbles.§

* Genesis viii. 22. † Ibid., xviii. 6. ‡ Ibid., xxx. 14.

§ The following is the account of Ceres in the Arundel Marbles:—"12. B.C. 1409.—Since that Ceres came to Athens, and taught there the art of sowing seeds in the earth, and sent Triptolemus, the son of Celsus and Neæra, into other countries to teach them the same art under Erectheus, King of Athens, there have passed 1145 years.

"1406.—Since the same Triptolemus sowed grain at Raria, since called Eleusis, under Erectheus, King of Athens, there have passed 1142 years."

The Arundel Marbles were engraved 264 years before the Christian era, in the Island of Paros, one of the Cyclades, and were found there at the commencement of the seventeenth century. They were brought to England by Thomas, Earl of Arundel, soon after; and in 1628 the learned Selden published an English translation of them.

The Valley of Enna, and that of Trinacria, in Sicily, where Ceres resided, are considered to be the cradle of agriculture; and it is said that the canonisation of Ceres in the heathen mythology, was the reward for her having transformed the *Ægilops ovata* into wheat, by cultivation. Homer, who lived two or three centuries after Ceres, makes mention of beer of a potent quality, made from wheat, which shows that its cultivation was then practised. In Italy, from the earliest establishment of the Roman commonwealth, agriculture was the universal occupation of the freemen. Great attention was paid to the cultivation of wheat, as is shown by the writings of Columella and other writers of that country. "The most profitable grain for man," says that author, "are common wheat, and bearded wheat. We have known several kinds of wheat, but of these we may chiefly sow what is called the red wheat, because it excels in both weight and brightness. The white wheat may be placed in the second rank, of which the best sort, in bread, is deficient in weight."

The Romans introduced the culture of wheat into England; and it is probable that the "red wheat," mentioned by Columella, was the same as the *Triticum hybernum*, or Lammas wheat, still so extensively cultivated in England and northern Europe, whilst the present spring wheat was represented by the *Trimestrian*, or three-months wheat, sown by the Romans to make good the deficiency in, or the entire failure of, the winter wheat.

It has been remarked that the cultivation and use of wheat follows and marks the progress of civilisation. This is because it demands a higher and more thoughtful process of husbandry than any other grain, and it is besides a more luxurious and expensive article of diet. The inhabitants of northern Europe consume but little wheaten bread, except the very highest ranks of society. Rye, barley, and oats are the principal farinaceous food (with potatoes) of the great bulk of the populations, and a traveller who wishes to enjoy the luxury of a wheaten loaf of bread, in Prussia or any of the minor German states, must himself prepare a supply to take with him. Both Jacob in 1825, and Laing in 1850, state, that in their journey from Berlin throughout Germany, they saw no wheaten bread at any of the public inns or private houses until they arrived in France. In England, where its consumption is now universal, it is not a great many years since rye and barley bread constituted the chief food of the rural population. At present, such is the improved condition of the operative classes, that wheaten bread is accessible to all, and, with other improvements in the mode of living, adds greatly to the sanitary condition of the country.

Naturalists have assigned to wheat a zone or belt, within which it is considered to be cultivated to the greatest advantage. This zone lies between the thirty-fifth and the fifty-fifth degrees of latitude, whether north or south. Below this range, the grain becomes large, ricey, thin skinned, hard, and dry; whilst above it, the berry gradually diminishes in size, and the bran becomes thicker, rendering it very inferior in commercial value to that grown within the belt. Cultivation, however, or the want of it, has much to do with the modifications to which this grain is subject. In the northern part of Scotland, for instance, under the fifty-eighth degree of north latitude, where, a few years since, the climate was so cold and damp that no grain would ripen properly, and the cultivation of wheat was never attempted, that plant is now grown with the greatest success. This change has been facilitated by drainage and other improvements of the land, which, as we have before observed, have, at the same time, ameliorated the climate; the winters becoming shorter and less severe, and the summer's heat less excessive, than formerly.

But although there is certainly a belt of the earth's surface peculiarly favourable to the wheat plant, it is equally true that it has the faculty of accommodating itself to almost any soil or climate, by submitting to modifications which do not destroy its general utility as food, although the proportion of nutriment it yields may be determined by the local influence of those elements. Wheat is cultivated with success on lands within the tropics, at a certain elevation above the level of the sea; and it is also produced in the colder regions of the north,—as in Scotland at 58°, in Norway at 64°, in Sweden at 62½°, in Western Russia at 60° 15′, in Central Asia at 60°, &c., &c. In Eastern Russia, on the Steppes, one hundred miles inland from the borders of the Crimea, wheat grows half spontaneously; that is, after the first crop, the land is seeded for the next two or three years by the shelled corn of the crops. It is remarkable that in no country is the grain produced so free from extraneous seeds of wild plants as the wheat from those Steppes. In other respects the grain shows the want of proper cultivation in the smallness of the berry, compared with that of Western Europe. Yet it possesses great strength, and is useful for mixing with softer corn. On the other hand, on the rich and luxuriant plains of Mexico, around the city of Xalapa, and nearly on a level with the sea, wheat grows with great rapidity, and attains an enormous height, *but it bears no ear*, and is only cultivated as fodder for cattle, as rye and tares are grown in the neighbourhood of our large cities, for the same purpose.

At the period of the discovery of America, that continent possessed no cereal plant, except maize, which the Indians were found cultivating by the discoverers. Wheat and other European plants were conveyed thither by them; but there was none in South America until about the year 1536, when a Spanish lady, Maria d'Escobar, the wife of Don Diego de Chauves, carried a small parcel of wheat from Spain to Lima (then called *Rimac*). This was planted by her, and she distributed the produce amongst the colonists. Wheat had, a few years previously, been introduced into Mexico through a slave, who found three grains of it in a parcel of rice. His master, Cortez, caused them to be planted, and they were the parent stock of the present Mexican wheat.

About the same time a vase full of wheat was taken from Europe to Quito by a monk of the order of St. Francis. It was planted by the fraternity of the convent, and succeeded perfectly. The vase is still preserved, and, with the name of the monk,—Jodoso Rixi,—is held in great veneration by the fraternity. They showed the vase to Baron Humboldt, when he visited Quito, and requested him to explain a motto in German, which, in ignorance of that language, they thought referred to the wheat. But it proved to be the pious admonition, "Let no one drink out of this vase without thinking of God."

Wheat is cultivated extensively in British India, and some of it has been imported from thence into the United Kingdom. Previous to the conquest of the country, it was unknown to the natives, which appears strange, when we consider that in Persia it grows spontaneously; that it is indigenous in the countries bordering on the Mediterranean; and that in the works of Diodorus Siculus and other ancient authors, as translated by Sprengel, many passages occur to prove the probability that most of our European grains grew wild in the northern parts of Persia and India. If, as Humboldt suggests, these were really found in a wild state, being only vestiges of an abandoned cultivation, still their existence proves that they were once the object of culture; especially when it is considered that in all the cities and ports of Palestine, wheat was an important article of commerce. Solomon paid Hiram, King of Tyre, 20,000 measures of wheat for his services in the building of the Temple, and "wheat of Minneth" was sent from Judah and Israel to Tyre, which city had large intercourse with Persia and India. Be this, however, as it may, rice has for a long period superseded every other grain in India, and now constitutes the almost exclusive food of the rural population.

In all the colonies of the United Kingdom wheat is cultivated with the greatest success. In the Cape of Good Hope and Australia the quality of the grain is exceedingly good, and the weight extraordinary. The gold discoveries in the latter country have, however, to a great extent, checked agriculture, by diverting the attention and the labour of the colonists from the farm to the "diggins."

WHEAT—ITS CHARACTERISTICS.

1st. *Its Chemical Composition.*—According to the analysis of M. Boussingault, wheat and wheat-straw are composed of the following substances in the specified proportions:—

	Wheat.	Wheat-straw.
Carbon	46·1	48·4
Hydrogen	5·8	5·3
Oxygen	43·4	38·9
Nitrogen	2·3	0·4
Ashes	2·4	7·0
	100·0	100·0

The four first of these substances are furnished directly, or indirectly, by the atmosphere; the last alone being derived from the soil. Small, however, as is the proportion of ashes in vegetable substances, they are found on analysis to be possessed of a variety of matters, as the following table shows:—

	Ash of Wheat.	Wheat-straw.
Phosphoric acid	47·0	3·1
Sulphuric acid	1·0	1·0
Chlorine	traces	0·6
Lime	2·9	8·5
Magnesia	15·9	5·0
Potash	29·5	9·2
Soda	traces	0·3
Silica	1·3	67·6
Alumina	0·0	1·0
Moisture and loss	2·4	3·7
	100·0	100·0

These constituents are elaborated in the grain of wheat into the following gross substances:—

Gluten.	Saccharine.	Water.
Starch.	Gum.	Bran.

In order to ascertain the proportions of the constituents of wheat derived from the atmosphere, M. Boussingault grew two successive crops of wheat on a soil destitute of nitrogen, but manured with 20,000 kilogrammes (nearly 20 tons) of farm-yard manure per hectare. The produce was 3·318 kilogrammes of wheat, and 7,500 kilogrammes of straw,* and the following table shows the weight when dried, and the proportions of the component parts :—

	Weight dry.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ashes.
Wheat	2·836	1037·4	164·5	1230·8	65·2	68·1
Wheat-straw	5·550	2686·2	294·2	2159·0	22·2	388·5
Total . . .	8·386	3993·6	458·7	2389·8	87·4	456·6
Manure . . .	4·140	1482·1	173·9	1068·1	82·8	1333·1
Difference . .	4·246	2511·5	284·8	2321·7	4·6	876·5

From this table it appears that the manure supplies nearly half the materials of the crops, and almost the whole of the nitrogen, whilst the ashes constitute nearly one-third of the whole weight of the manure.

The value of wheat is determined by the proportions of the gross substances of which it is composed. These vary according to the description of wheat, or the climate of the country in which it is grown, or the nature of the soil, or the quality of the manure. The quality is also greatly affected by the state of the weather before, or at the time, of harvest. The two most important elements contained in it are gluten and starch, the composition of which is as follows :—

	Starch.	Gluten.
Carbon	43·55	52·883
Oxygen	49·68	23·872
Hydrogen	6·77	7·540
Nitrogen	0·00	15·705
	100·00	100·000

The effect of different manures in changing the proportions of these elements has been singularly illustrated by M. Boussingault, in an experiment recorded in his work on agricultural chemistry, of which the following are the particulars :—

Manures.	Gluten.	Starch.	Bran and soluble matters.	Total.
1. Human urine . . .	35·1	39·3	25·6	100·0
2. Bullocks' blood . . .	34·2	40·3	25·5	100·0
3. Night soil	33·1	41·4	25·5	100·0
4. Sheep's dung . . .	32·9	42·8	24·3	100·0
5. Goats' do.	32·9	42·4	24·7	100·0
6. Horses' do.	13·7	61·6	24·7	100·0
7. Pigeons' do.	12·2	63·2	24·6	100·0
8. Cows' do.	12·0	62·3	25·7	100·0
9. No manure	9·2	66·7	24·1	100·0

The results here are very remarkable, the contest being kept up between the gluten and the starch, there being a very slight difference in the quantity of the other materials in the third column. As the amount of gluten decreases, that of starch increases in nearly an equal proportion, the maximum of the former being 35·1 and minimum 9·2 per cent., whilst those of the starch are 39·3 and 66·7 per cent., the difference between the highest and the lowest of the gluten being 25·9, and that of the starch 27·4, whilst the rest of the materials show an excess in the maximum of only 1·5.

Gluten being the substance that imparts strength to the flour, the wheat which

* This amounts to 124 bushels of wheat, and about 7½ tons of straw per acre *in the two crops.*

contains the largest proportion of it must be the most valuable to the baker and the consumer. Gluten is of the nature of animal sinew or tendon, and contains $14\frac{1}{2}$ per cent. of azote or nitrogen. The proportion of gluten in flour, determines the quantity of bread it will make from a given weight of flour, or rather the quantity of water it will absorb. The millers, therefore, who desire to have the best, that is the strongest, flour, select those wheats which are known to contain the largest amount of gluten.

Starch, on the contrary, possesses of itself alone, no nutritive properties, nor could it sustain life for any length of time; but it is well calculated to modify the astringent properties of gluten, with which it is so intimately blended in cereal produce. The proportion also contained in wheat determines the value of the grain to the starch-maker; it is, therefore, evident that No. 9 in the last table must be more desirable to him than No. 1, containing as it does 27·4 per cent. more starch; whilst No. 1, which contains nearly four times the quantity of gluten to No. 9, is worth several shillings more per quarter to the miller or baker, as producing a better quality of flour and a larger proportion of bread.

2nd. *Wheat, its constitution.*—There is not any other of the cerealia that possesses a more hardy constitution than wheat, or that can more effectually withstand the changes of temperature in the earlier stages of its existence. It has the faculty of adapting itself to almost every climate or soil in which vegetation of any kind flourishes. It has all the vitality of common grass, and can bear the vicissitudes of heat and cold, drought and moisture, without material injury. We have known excellent crops reaped after a season so dry, that scarcely a shower fell between April and harvest. Instances also have been known in which, during a temporary flood, wheat has remained under water so long that all other vegetation has been destroyed; yet, when the water subsided, the wheat has sprung up from the root uninjured, and produced a good crop. Nor will any degree of frost destroy it in the earlier stages of its growth, if the proper precautions are used for its protection after the frost has gone. The only period of danger from this cause is the occurrence of a frost when, or after, shooting the ear, which, in fact, is the most critical period of its existence.

Frequently have we seen, in the eastern counties, fields of wheat over which, in the spring, the bitter east wind, fresh from the German Ocean, has swept for weeks with a severity that destroyed every vestige of vegetation; so that a stranger, accustomed to the warmer climate of the south, would be at a loss to know whether the land was sown or not, this state of things sometimes continuing until May; and every farmer of any standing, can recall instances in which it was a doubtful point whether it would be most prudent to let the field remain or to plough it up, and sow it with other grain. Yet, all this time, the plant which thus lies concealed, is gathering strength at the root, and forming its tillers or offsets, ready to be pushed forward as soon as the genial rays of the sun are brought to bear upon it. Many such a field as we have described, has after all produced an abundant crop.

From a long consideration of the subject, and a considerable amount of personal observation, we are inclined to believe that no plant of wheat, if sown in proper time, and treated with the proper precautions, was ever destroyed by frost. The most common way in which frost is supposed to injure wheat is by promoting the root-fall. This disease, as it is called, usually attacks the late-sown wheats, and its *rationale* is as follows: wheats, sown late—say in November or the beginning of December—have but little time to send their roots downward into the soil, and the rains of autumn or early winter swell the ground and raise the plants to the surface. When the frost sets in, the moisture is evaporated; and as soon as the thaw succeeds the soil falls from the young roots, leaving them exposed to the sun and wind without any support, and the plant dies. The only remedy is passing a heavy roller over the surface, or driving a flock of sheep, either of which closes the soil about the plant, and helps it to take a fresh hold of the ground.

The most effectual prevention, however, of the root-fall is to plant or sow early, so that the young plants may have ample time to strike their roots deep and take a firm hold of the ground before winter. The tap-root of wheat penetrates as much as five or six feet in some soils, and in all, when deep tillage is practised, and if sown early, soon gets out of the reach of danger from root-fall.

The light peaty lands of Lincolnshire are particularly liable to this disease, and every dry spring many fields of wheat are destroyed by it. A farmer who a few years since took a farm in that county, having, the first year of his occupation, had several acres of wheat almost wholly destroyed, took the precaution the following year, after the wheat was sown, to cover the whole surface with clay to the depth of three inches. His neighbours blamed him severely for this, and prophesied that the wheat would never come up through the clay. So far from this being the case, it came strong and vigorous, and whilst the lands of his neighbours suffered, as usual, from the root-fall, he never lost a plant; and at harvest he reaped double the crop of any farmer in the vicinity.

There is, however, one condition in the management of the farm necessary to the perfect success in the cultivation of wheat, as well as every other kind of vegetable produce, namely, getting rid of the surface water by drainage. The continued presence of this enemy, especially on strong clay soils, calls for one of the most important operations in good husbandry; and yet, strange to say, although its necessity has been pointed out by every writer of eminence, from Fitzherbert to those of the present day, scarcely one-third of the clay soils of England have been drained. The injurious effect of the retention of surface water upon the wheat plant, is annually felt by the heavy land farmers, and yet they go on, year after year, without applying the remedy. The subject will come more fully and immediately under consideration at a future portion of this work; but it was necessary to refer to it in speaking of the causes of the failure of the wheat plant, of which it is one of the most palpable of those the remedy for which is in the cultivator's own power to apply.

The destruction of the plant is not the only evil that arises from the neglect of drainage. Mildew and blight are the usual diseases that attack it, and the richer the land in manure, the more liable is the plant to be injured. In that case the presence of water renders the straw long and lazy, and liable to be lodged by the wind and rain. In such instances the grain is usually coarse and thin, and deficient both in weight and in yield.

The grain of wheat loses a portion of its vitality every year after the second or third season from its maturity. The usual practice is to sow the new seed just harvested; but it is a question whether it would not be advantageous to employ over-year seed, which appears to be the most natural method. The proper time for sowing is the beginning of September; and it is seldom that the opportunity of threshing the seed from new wheat occurs so early. But besides this, the grain, although possessing full vitality as soon as it is ripe, has not attained its solid maturity until a year has passed over it. One proof of this is the superior strength of the flour made from old wheat, to that which is made from the new immediately after harvest. On the same principle, it is rational to suppose that wheat of the second season would produce *less length of straw, but a heavier ear and grain.* We would not recommend sowing wheat older than the second year, after which its vitality begins to decline, unless kept in the straw, which will probably preserve it somewhat longer.

WHEAT—ITS POWER OF PRODUCTION.

The rapid increase of the population, and, consequently, of the consumption of bread-corn and other provisions in the United Kingdom has raised the question how the wants of the people are in future to be provided for, especially in case of war with any of the wheat-growing countries from whence we now obtain our supplies. At present the whole world is open to our commerce so far as purchasing is concerned; but the time has been, and that within the memory of many of us, when that whole world was shut against us, and we could look to no quarter for a supply. It is true the population was then not more than half what it now is, and the vigorous efforts of the government to cause the waste lands to be brought under cultivation led to the increase of production, so that, except in the case of a failure of the crop on one or two occasions, no absolute scarcity was felt; and from the peace of 1815 to the present time the corn trade with foreign nations, under various restrictions and modifications, has been sufficiently open at all times to enable us to meet the growing demands of the community; whilst, under the present laws, all restrictions upon the trade are abolished, and the United Kingdom has become the granary of the whole world.

But who will be able to say that the state of that world is such as to lead us to hope that this freedom of commerce and abundance of supply will not be interrupted by war? Can we look either eastward or westward,—to the continent of Europe or that of America,—and affirm that the supply of bread-corn is as certain for us in the future as it has been in the past? Even if no breach with the United States occurs, will they be able, with such enormous draughts upon the rural population for the support of the civil war as are now threatened, to cultivate the land and grow corn beyond their own wants sufficient to supply us as heretofore?

Such questions must press themselves at times upon the mind of every reflecting man, and force upon him the problem of supply in case of war, now that the population is 30,000,000 instead of 15,000,000, as it was at the beginning of the present century;* and this naturally leads to the inquiry whether the land under, or capable of, cultivation in the United Kingdom might not be made so much more productive as to furnish enough without having recourse to foreign aid? This inquiry comes directly within the range of our present subject—the productive powers of the wheat plant, which is the most important of our agricultural productions.

If we except a comparatively few isolated instances of experiments, made on a small scale by amateur farmers, the fertility of this plant has never been tested to the extent its importance demands, considering the critical position of England at the beginning of

* In the year 1801 the population of Great Britain was 10,942,646, and of Ireland 4,500,000, in all, 15,442,646.

this century, and which state of things may possibly again occur. Yet enough has been done to prove that, with a proper care and attention in the cultivation of wheat, there is no assignable limits to its productiveness; and that it is within the range of probability, that not only could enough wheat be grown to supply ourselves, but that England might become an exporting, instead of an importing, country, were the powers of her soil and her cereal plants increased to the extent of which they have been shown to be capable. We shall adduce a few instances of experiments illustrative of this proposition.

The first is that of Mr. Miller, who was the curator of the Botanical Garden at Cambridge about a century ago; and the facts which we are about to state are inserted in the Philosophical Transactions of the Royal Society (vol. lviii. p. 203), to the following effect :—" Mr. C. Miller, of Cambridge, sowed some wheat on the 2nd June, 1766; and on the 8th August one plant was taken up and separated into eighteen parts, and replanted; these plants were again taken up and divided in the months of September, and October, and planted separately to stand the winter, which division produced sixty-seven plants. They were again taken up in March and April, and produced 500 plants. The number of ears thus formed from one grain of wheat was 21,109, which gave three pecks and three-quarters of corn that were estimated at 576,840 grains." The land is stated to be of medium quality, and no manure was applied.

This remarkable experiment, the details of which there is not the smallest reason to doubt the truth of, is referred to by Sir H. Davy in his work on the "Elements of Chemistry," and there are several important considerations arising out of it. The early period at which the grain of wheat was sown (2nd June) ensured for it a rapid development of its tillers. The first division and replant took place on the 8th August, nine weeks after the seed was planted, and before the usual time of sowing commences; the second division was made when that operation was at its height, namely, in September and October; and we may, therefore, consider the sixty-seven plants it produced as representing so many plants grown from early-sown seed. The third and last division was effected just as the spring was about to exercise its renovating influence on the face of nature, and the large number of tillers thrown out during the winter months (seven and eight to each plant) is very remarkable; but this was as nothing compared with the subsequent increase, which gave an average of forty-two ears to each of the 500 plants, and of twenty-seven grains to each ear! Let us now see what would be the result if such an operation were to be carried out on a large scale.

There are 13,560 feet in an acre of land. If we divide this by 500, on the supposition that each of the plants occupied a square foot of ground, we find there are 87 such spaces in the acre. The 500 plants produced $3\frac{3}{4}$ pecks of wheat; if, therefore, we multiply this by 87, it gives $326\frac{1}{4}$ pecks, or 10 quarters, 1 bushel, $2\frac{1}{4}$ pecks per acre.

This was no apocryphal produce, and the only question is, whether it is capable of being carried out upon a large scale? The father of Miller, who was the author of the "Gardener's Dictionary," states in that work that "the finest field of wheat he ever saw was sown in rows, at a foot and a half distance. The allowance of seed to this field was three gallons, whilst by the common practice of the farmers there was seldom less than three bushels per acre, which is eight times as much. This wheat was hoed by the hand twice in the spring, which cost 5*s.* 6*d.* per acre; when the corn was in ear, it was not less than six feet high; there were from twelve to twenty stalks on each root, which were so strong as to all stand upright. The ears were very long, the ground perfectly free from weeds, and the produce was more than *eleven quarters per acre of land*. These experiments, one should imagine, would excite a desire amongst the farmers to adopt the practice; but, on the contrary, *not one of those in the neighbourhood would follow it*." * Miller also states that he has known eight to ten quarters reaped upon an acre, over the whole field, and sometimes more; "and," he adds, "I have been informed, by persons of credit, that on good land, which was drilled, and managed with the hand-hoe, they have had twelve quarters per acre."

In the same work is given an account of a long series of experiments on the Tullian system, by M. Lulliac de Chateauvieu, on a farm near Berne, in Switzerland, and such was the success,—the produce being half as much more than on the old system,—that he adopted it with his whole crop of wheat of 200 acres. No manure was applied, yet the land, after four years cropping with wheat, increased in productiveness, which he justly ascribed to the more perfect pulverisation of the soil.

Varlo, a practical farmer, who published a work of three volumes on Agriculture, which ran through three editions, the last of which had a numerous list of subscribers, relates many instances in which, with single seeding at wide distances, a produce of from 50 to 80 bushels was obtained.

This question, however, of the prolificness of the wheat plant, is in a fair way of receiving its solution in the present day, having been taken up by several persons who have both the means and the disposition to carry it out to the utmost on an extended scale. The practice of the Tullian husbandry, with the improvements which modern science has suggested, is adopted by many persons experimentally, and especially at Lois Weedon, in Buckinghamshire, by the Rev. Mr. Smith, whose proceedings are well-known and understood. For thirteen consecutive years he has sown wheat on half the same field alternately, and produced from 35 to 40 bushels on the half acre, or from 70 to 80 bushels per acre, the quantity of seed planted being only from one to two pecks per acre, no manure being ever applied during that long period.

But the most extraordinary and extensive experiment to test the prolific character of wheat, and, we may add, the most successful too, is that of F. F. Hallett, Esq., of the Manor House, Brighton. This gentleman farms altogether about 600 acres, in the neighbourhood of Brighton; and, possessing ample means for carrying out his plans, he has established a system in the culture of wheat, which, from the wide-spread publicity it has attained, the large number of persons who have been induced to adopt his plan experimentally, and the success they have also generally met with, is likely to produce a complete revolution in the practice of wheat planting. We shall now state the system upon which Mr. Hallett has proceeded in raising the stock of wheat he terms "the Pedigree Wheat," as described by himself, the leading principle of which is, allowing each plant sufficient room to fully develop itself; or, in other words, thin seeding.

"A perfect plant of wheat," he says, "consists of three principal parts,—viz., the roots, the stems, and the ears. When a grain is planted under the most favourable circumstances, these are produced as follows:—Shortly after the plant appears above the ground it commences to throw out new and distinct stems, upon the first appearance of each of which, a corresponding root-bud is developed for its support, and while the new stems "tiller" out flat over the surface, their respective roots assume a corresponding

* Miller's "Gardener's Dictionary," under the article "wheat," first published in 1723.

development beneath it. This process will continue until the season arrives for the stems to assume an upright growth, when "tillering" ceases, and the whole vital power of the plant is concentrated upon the production of the ears. These will be the finest it is capable of producing, unless the growth of its roots have been in any way interfered with, as by having been cramped or crowded by those of other plants, when the size of the ears will be proportionately diminished. I wish to avoid scientific terms as much as possible, but, as a convenient mode of expression, I shall henceforth speak of the "tillering" process accompanied by the corresponding growth of the roots as "the *horizontal*," and of the comparative length and contents of the ears produced, as the "*vertical*," development or growth of the plant. I shall also, for like reason, designate as the "*natural*" mode of cultivating wheat, that which gives free play to its nature.

"The extent to which horizontal development may take place, is seen in the fact, that the stems produced from a single grain, having perfect freedom of growth, will, in the spring, while lying flat upon the surface, extend over a circle three feet in diameter,* producing at harvest from fifty to sixty ears.

"That vertical development is dependent on horizontal growth being unimpeded, has been abundantly shown to me, in the observations I have made upon the growth of wheat under different conditions. It is generally illustrated in the experience before alluded to, that a thinned crop produces fine ears; and a more particular illustration of this principle will be presently seen in the case of the original ears, with which I commenced. These had been grown in the usual way, in a field seeded with two bushels per acre; but by simply planting their grains separately, so as to admit of the full horizontal growth of the plants, the vertical development was, in the following harvest, nearly doubled.

"This fact is pregnant with practical inferences, bearing upon the present mode of culture, which by the use of superfluous seed, crowds the plants and produces ears of only one half the natural size.

"It has for the last twelve years been my conviction that a good pedigree is as valuable in plants as in animals; and that in the careful rearing of seed that has this qualification, lies our only means of materially increasing the produce of the cereals. Amongst animals, whether horses, cattle, sheep, or pigs, the importance of pedigree is fully recognised, as also even in reference to some of our agricultural *plants*; for if a farmer wants a good cabbage, mangold, turnip, or carrot, he selects the seed from a good *parent*; but the moment he deals with the cereals, he almost ignores the great principle that *like produces like*, which he admits in the foregoing cases, to be not only a right one, but so important as to deserve much attention, and repay much outlay. Yet the minutest characteristics of a plant of wheat will be reproduced in its descendants; so much so, that we can not only perpetuate the advantages presented to us in an individual ear, but by the accumulation of selection, make further advances in any desired direction."

In accordance with this principle Mr. Hallett proceeded to raise a stock, by selecting the best ears for seed, and in four years he succeeded in increasing the size of the ear in the following ratio:—

	Length, inches.	Containing grains.	Number of ears on finest stool.
1857. Original ear	$4\frac{3}{4}$	47	—
1858. Finest ear	$6\frac{1}{4}$	79	10
1859. Finest ear	$7\frac{3}{4}$	91	22
1860. *Ears imperfect, from wet season*	—	—	39
1861. Finest ear	$8\frac{3}{4}$	123	52

* The writer saw a plant of wheat at Mr. Hallett's farm which measured 5 feet 8 inches across.

"Thus, by means of repeated selection *alone*, the length of the ear has been doubled, their *contents* nearly trebled, and the 'tillering' power of the seed increased five-fold."

Such is the principle on which Mr. Hallett has raised the stock of wheat he now cultivates on his farm of 600 acres, and which he has offered for sale to the public. In the present year (1862) he has 90 acres, seeded with from one peck to one bushel per statute acre, according to the period of sowing. The land he occupies near Brighton is of the most ordinary kind, being a thin soil of about six inches depth, over an interminable chalk. Some of this land is naturally so infertile—one field in particular—as to have been proverbially incapable of growing wheat at all; yet, on this very field, with a seeding of one peck per acre, a crop of 48 bushels per acre was raised this season.*

Mr. Hallett considers that if the wheat is planted in September, it should be deposited in single grains, nine inches apart every way, which would be equal to one bushel to every six acres. If planted later, the grain should still be deposited singly, but at a less distance apart. What early planting will do in ensuring success, he shows by an experiment in 1860—a year of signal failure in the wheat crop. "The Pedigree Nursery wheat planted singly, September 9, 1859, in holes nine inches apart every way, produced in 1860, notwithstanding the very disastrous character of the season, $1\frac{3}{4}$ bushel on 698 square feet of unmanured land, or 108 bushels per acre." From his own practice he recommends the following apportionment of seed to the period of sowing, the grain being dibbled singly in holes not exceeding $1\frac{1}{2}$ inch in depth:—

	Between rows of—	In rows of—	Quantity of seed.
In August or early in September	9 inches	9 inches	1 bushel on 6 acres.
In September	9 ,,	6 ,,	1 ,, 4 ,,
In October	6 ,,	6 ,,	1 ,, $2\frac{3}{4}$,,
Towards end of October	6 ,,	4 ,,	1 ,, 2 ,,
After October	6 ,,	3 ,,	$1\frac{1}{2}$,, 2 ,,

The advantages of early sowing are forcibly insisted upon as calculated to secure the plants from many of the dangers to which they are liable when late sown, and vegetation becomes less rapid and vigorous. But, besides this, the small quantity of seed required, although a secondary, is no trifling object to the farmer. On 100 acres, one bushel to six acres, instead of two or three bushels per acre, which Mr. Hallett's neighbours are in the habit of employing, creates a saving of from 180 to 280 bushels, which, at 6*s*. per bushel, amounts to from £54 to £84. But even supposing it is not possible in all cases to get all the wheat sown in the month of September, by commencing in that month it affords an extension of the seed-time, and gives greater opportunity for selecting the proper time in regard to weather, &c. When the commencement is postponed to the latest period, the chances are greatly against a favourable result. Early sowing also affords time for replanting in case of failure, either in whole or in part. But in proof of the diminished risk in early sowing, Mr. Hallett states, that of 500 persons who adopted his system with the Pedigree wheat in 1861, only *two* reported to him the destruction of the crop,—one by excessive drought, the other by the slug.

Such is the system pursued by Mr. Hallett, whose proceedings have attracted the

* The writer saw this, with the other crops, and can bear his testimony to the remarkable length of the ears, stoutness of the straw, and fineness of the grain.

attention of the agricultural world, not only in England, but in France, Germany, Spain, and the British colonies. The principle, in fact, on which the system is founded is so important, that no apology is necessary for introducing it in detail into this work, illustrating, as it does, the extraordinary productiveness of the wheat plant, and the best means for its development.

DIFFERENT SPECIES OF WHEAT.

The wheat plant is placed by botanists in the genus *Triticum,* which comprises forty species, sixteen belonging to the continent of Europe, while five only are natives of Great Britain. They are subdivided into two groups, namely, the *Cerealia,* or such as, being convertible into human food, constitute the subjects of cultivation and harvests; and the *Agrophyra,* or mere grasses. It is of the first that we have now to treat.

The *Cerealia* are divided into *Frumentæ,* or those plants whose seeds when ripe fall from the chaff; and the *Speltæ,* or spelts, the seeds of which remain attached to the chaff. The most important of the *Frumentæ* are—1st. The *Triticum vulgare,* comprising the *Triticum æstivum,* and the *Triticum hybernum;* 2nd. The *Triticum turgitum,* including about ten varieties, half of which are spring, and the other half winter wheats; 3rd. *Triticum durum,* the true bearded wheat; this is a native of Switzerland, all the varieties of which are spring wheat, and are much cultivated in Spain, Italy, and Sicily; 4th. *Triticum compositum,* or the Egyptian many-spiked wheat, also termed "the corn of abundance." It has been cultivated in Egypt for many ages, and answers to the description given in the sacred Scriptures of the seven-eared corn of the plentiful years foretold by Joseph.* It has for many years been cultivated in England, especially on the strong lands of Suffolk and Essex, where it is known by the name of "Club-wheat." This species is remarkable for having a solid stem, by which it is enabled to resist the violence of the winds, so that it is seldom laid, notwithstanding the heaviness of the ear. The straw is very valuable for thatching, being more durable than common wheaten straw. 5th. *Triticum Polinicum,* or Polish wheat, commonly known as Dantzic wheat; this is a spring wheat, and is adapted to countries in which the summers, though short, are warm and equal; in quality it is considered superior to any other species, but yields less flour than the more common kinds.

Triticum spelta comprises only two species, one awned or bearded, the other unawned. The bearded spelt embraces two varieties, *Triticum dicoccum,* or two grained, which is extensively cultivated in Germany; and *Triticum monoccum,* or single grained, chiefly found in Switzerland. The straw of this latter is particularly hard and firm,

* Herodotus gives the following account of the amazing fecundity of the Egyptian wheat in his day:—"Of all the countries that have come within my observation, this is far the most fertile in corn. The soil is so particularly well adapted to corn that it never produces less than two hundredfold. In seasons remarkably favourable it will sometimes rise to three hundredfold. The ear of their wheat, as well as barley, is four digits (or inches) in size (or round). . . . . I am well aware that those who have not visited this country will deem whatever I may say on this subject a violation of probability," &c. On this passage a modern writer (Le Couteur) remarks, "This elegant and authentic writer, who flourished about 450 years before the Christian era, speaks of wheat producing two or three hundredfold. It is true the soil and climate of Egypt are both highly favourable to the growth of wheat, but that produce is not extraordinary if compared with the produce of single ears of corn; as No. 7" (an experiment of his own) "which produced 4 lbs. 4 oz. from fifty-six grains. Reckoning 9,000 to the pound, this is a produce of six or seven hundredfold. Hence, may not British culture be hereafter brought to equal Egyptian produce?" We add that this season we have seen a field of wheat, seeded with *one peck per acre,* the yield of which is estimated by competent judges at ten quarters per acre, or three hundred and twenty-fold.

and is well adapted to thatching, and also to the manufacture of plaiting for straw bonnets. Neither of the spelt wheats are now cultivated in this country, having been found unprofitable.

Besides the above generic and specific kinds of wheat, there are continually new varieties produced—the effect of accident, or cultivation, or the difference of soil, climate, &c. It would be an endless, as well as profitless, task to specify the 150 or 200 of these varieties. We shall, therefore, confine ourselves to a description of the characteristic excellencies of the most valuable of those cultivated in the United Kingdom.

Triticum æstivum, a spring wheat, is a valuable plant on account of its being available as a resource, either in the case of a total or partial failure of the winter wheat, or the prevention of the sowing it at the proper season, or as a substitute for barley, or any other kind of spring corn after turnips. The produce of spring wheat is not usually so great as that of winter wheat, nor will it fetch so high a price at the market, not being so heavy. It requires also a great quantity of seed, as it does not tiller so much as winter wheat. The result, however, is more certain, as the casualties of the winter and early spring are avoided, and the return is more rapid, three or four months sufficing to bring it to maturity, if the season is ordinarily favourable. It is considered to be a native of Siberia. The ear is slender, the awns long, the produce small, the stem delicate. It is frequently sown on patches where the winter wheat has failed, by which a regularity of plant is obtained at the expense of a mixed produce.

Triticum hybernum is the Lammas or winter wheat, of which there is a greater variety than of any other kind. They are all stronger in the straw, longer and fuller in the ear, and more abundant in tillering than the spring wheats. They comprise both red and white, bearded and awnless varieties, and an endless series of modifications of these, the effect of local or accidental circumstances. The red-grained varieties are considered to be more hardy than the white, but not so prolific. They are, however, more extensively cultivated, being less liable to be affected by the casualties of the seasons than the white. The weight per bushel is generally greater, ranging fron 62 lbs. to 66 lbs., and sometimes more. Some Australian white winter wheat, however, has recently been received in England weighing 70 lbs. per bushel, which is chiefly to be ascribed to the excessive dryness of the atmosphere of that country.

These two species of summer and winter wheat are commonly cultivated in every country of the civilised world, but exhibiting an endless series of varieties. No plant, in fact, is more liable to "sport," or to be affected by local circumstances, so as to cause a deviation from the original type in the produce. A remarkable instance of this is shown in the Kentish white wheat, which, when transported to, and cultivated on, the light gravelly soils of the eastern counties, very soon changed its character, and assimilated itself to the common red wheat of those counties. No plant, either, will degenerate faster, when the soil is unfavourable to its growth. A friend of the writer recently procured some seed-wheat of remarkably fine quality from the rich lands of Gloucestershire. This was sown on a rather light mixed soil in Norfolk, but the produce was very inferior to the seed. Thinking that this might be owing to the season, or other accidental circumstance, he tried it a second year; but the result was a still greater deviation from the original stock, and he then gave up attempting to cultivate it.

Continual changes are taking place in the varieties of wheat which obtain the favour of the agriculturists. Thus, the Talavera wheat, which was introduced into this country during the Peninsular war, was much cultivated for many years in Norfolk, the soil of which well suited it. But it was not found to be a good yielding stock, and was moreover so liable to sprout when on the shock, that its cultivation was, in a great measure, abandoned. It is still, however, a favourite species in Suffolk, especially round Bury St. Edmunds, and also in the districts round the metropolis. The Talavera wheat is a favourite grain with the millers, and will always command 3*s.* or 4*s.* per quarter more than any other kind of wheat of native growth, on account of its superior strength.*

The Nursery wheat, so called from the original stock having been found growing in a nursery-ground, is a great favourite with both farmers and millers in the districts round London. It is a red wheat, with a thin mellow skin, and it works kindly under the stones. In its original state it is not a very prolific variety, the ear being short (about 4½ inches). But it was the species selected by Mr. Hallett for his experiments in raising a new stock called the "Pedigree wheat;" and by careful selection for a series of years, he has succeeded in obtaining ears from six to eight inches in length; and he exhibits one ear measuring 8¾ inches, containing 123 grains, as shown in page 476. This wheat ear was exhibited at the International Show of the Royal Agricultural Society of England, and also at the International Exhibition of 1862, where it excited the astonishment and admiration of both foreigners and natives.

The Golden Drop is another favourite variety, and is cultivated throughout the country. Like the Nursery wheat it is a mellow working grain, and the flour is of a fine colour, whilst the skin is of a yellowish red hue. It is particularly grown in the districts round the metropolis. In the eastern counties, the Spalding and the Giant varieties are extensively cultivated. The former, as its name indicates, originated at Spalding, in Lincolnshire. It is a red wheat, yields well, and is of a hardy nature, standing the severity of seasons in those counties without injurious effects. It is reckoned by Morton to be the best of all the red wheats, yielding well, and attaining great weight per bushel. The grain is yellowish, the ear long and square; but it is rather tender, and requires to be mixed with other and stronger varieties in grinding.

The Giant wheat was, we believe, brought originally from the Island of St. Helena, where it grows to a prodigious height in the straw, and the berry is very large. It is considered a good yielding wheat, but is rather coarse, although the flour from it is strong.

The Hunter wheat was formerly a favourite variety in England, but has given way to other more prolific kinds, and is now chiefly cultivated in Scotland, the soil and climate of which are suited to it; and it has stood its ground there against all the new varieties that have been introduced. It is adapted to inferior soils, in which it tillers abundantly. The ear is of moderate length, semi-awned and thickest in the middle, the grain is brownish, of a close texture, and weighs well in the bushel, sometimes attaining 66 lbs. If sown on rich land it gets too luxuriant, and is apt to go down. It has been

* The Talavera wheat is exceedingly strong in gluten; and consequently the flour from it produces a larger quantity of bread than any other kind. The author once had some of it consigned to him for sale, which yielded 101 4 lb. loaves per sack of 20 stone, the usual number from the best London flour being 94 loaves. Some Russian flour, made from Kubanka wheat, was imported a few years since, which produced 108 loaves per sack—the greatest number ever known. Talavera wheat is less likely to "sport," or degenerate than other kinds, because it usually blooms a fortnight before the generality of species, and therefore runs no risk of being impregnated with the pollen of other wheats. This, in fact, is the cause that it has maintained its characteristic qualities.

much deteriorated in Scotland by admixture with other and new varieties; nevertheless, it continues to hold its pre-eminence, and "will bear comparison in the sheaf, stack, bushel, flour-mill, and bakers' shops," with any of the finer sorts.*

The Mummy wheat is said to have originated in wheat found in an Egyptian mummy. We have already mentioned this variety, which is remarkably prolific, having, in some instances, produced four thousand-fold the seed sown. The ears have from three to seven, and, in some cases, eleven, offshoots, and contain 150 grains, with 60 ears to one plant. It is adapted to a clay soil, and to small farming; but the grain is coarse, and the flour from it ricey, being used by the bakers as *colnes* for dusting their kneading-boards; and, if at all mixed in making bread, only in small quantities. The ear is thickly bearded.

The Old Lammas, or Red English wheat, is well adapted to inferior soils, but is rather of a tender constitution. It is largely cultivated in England and France, but has made no progress in Scotland, where the climate is too severe for it. The old Norfolk Red wheat is a hardier variety of the Lammas, and has been cultivated in the eastern counties for centuries. It produces a strong straw, and a long ear; the grain is of a deep red, and weighs well in the bushel, but the flour is not generally of the best quality, or so strong as the Talavera and some other varieties of white wheat grown on stronger soils.

The Chidham wheat is one of the oldest and finest varieties of white wheat in England, and is much cultivated in the districts of the metropolis. The straw is tall and strong, the ear very square, and without awns; the grain plump, and possessing starch rather than gluten, which detracts from the strength of the flour. It is suited to a lightish mixed soil well cultivated, in which it is early matured, and is seldom mildewed or laid. It seldom weighs less than 61 lbs., and sometimes reaches 67 lbs. per bushel.

The Pearl wheat, like the foregoing, contains a larger proportion of starch than gluten, producing flour of a weak quality. Nevertheless, it is much esteemed, not only for its whiteness, but for its mellow quality. The straw is stiff and long, the ear moderately large and square, the grain small, full, and white. It is a tender plant, but ripens early, and may be sown either as a winter, or a spring wheat.

The Red Chaffed wheat loves a rich soil, and where it is protected from the east winds. The straw is short, the ear very square, the chaff reddish, the grain white, plump, and round, and it generally yields a large return. The flour is of a good colour, and of medium strength.

The Velvet Husked wheat has a white, plump, thin-skinned grain, short straw, small, but compact close ear, and white downy chaff. When sown on light land, it yields scantily; but on rich, loamy soils, it tillers profusely and blooms early. On such lands it produces sometimes seven quarters per acre. From the woolly nature of the chaff it retains moisture, and is apt to sprout in a showery harvest, at the same time requiring a good weathering before it is carted. On this account its cultivation has been abandoned in Scotland, where the climate is moist.

It may be remarked in conclusion, that the red wheats generally, are of a more hardy nature or constitution than the white, being less liable to disease. They are, therefore, much more cultivated on the poor and medium soils of this country, than

* Morton's "Cyclopædia of Agriculture," article Wheat.

the finer sorts, while the white wheats are chiefly grown on clayey or loamy lands, well drained and tilled. There is, however, abundance of negligence displayed, both in choosing the proper varieties, and the best types of those varieties. The late Sir Joseph Banks was of opinion that a poor sample, or dross-wheat, was as proper for seed as the best and healthiest grain. That any man possessing the knowledge of natural history that Sir Joseph must have acquired, should broach such a proposition, shows the danger of adopting a theory without applying to it analogical reasoning. The whole system of reproduction, whether in plants or animals, falsifies this theory; and we do not believe that, in the present day, an agriculturist could be found, who, however ignorant he may be in other matters, would be foolish enough to adopt it in his practice. At the same time, there is still a want of caution in many farmers in selecting their seed corn, in not ascertaining the purity of the stock and the *oneness* of the species; and its adaptation to the soil for which it is intended. Le Couteur, in his excellent treatise on wheat, relates, that on one occasion, he invited Professor La Gasca to inspect his crops of that grain, which he himself considered to be as pure and unmixed as possible. To his dismay the Professor picked out of three fields, "twenty-three distinct varieties, some white wheat, some red, some liver-coloured, some spring wheat, some dead ripe, the corn shaking out, some ripe, some half ripe, some in a milky state, and some green."

Well might Le Couteur be dismayed at the reflection of what must be the effect of such a mixture, in which some of the crop would be inevitably shelled, before other parts of it were ripe enough to cut. And yet, any one conversant with the species of wheat, might any day go into the field of an ordinary farmer, and, without much difficulty, make a similar discovery. Nor can we wonder at this, when no care is taken in keeping the varieties distinct; but, on the contrary, they are frequently and purposely mixed—white with red—for seed, on the pretext of improving the sample! The produce of such mixtures must necessarily be a hybrid. The necessity for selecting the best grains for seed, was understood even in the time of the ancient Romans, as we learn from Virgil, with whose elegant lines we shall close this essay on wheat:—

> "I've seen the largest seeds, though viewed with care,
> Degenerate, unless the industrious hand
> Did yearly cull the largest. Thus all things
> By fatal doom grow worse, and by degrees
> Decay, forced back into their primevous state."

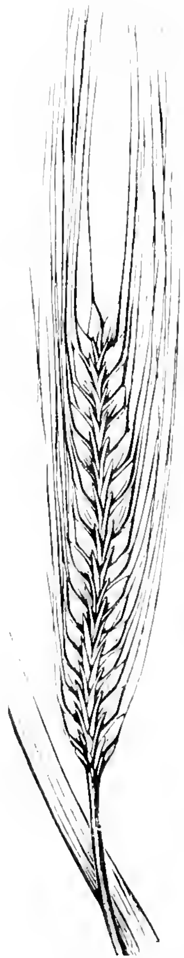
SECTION II.

BARLEY.

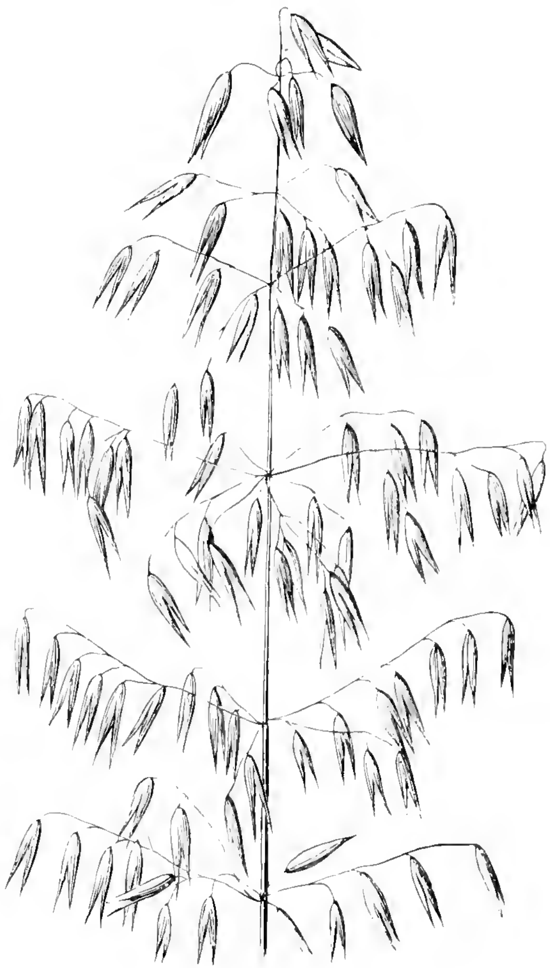
The barley plant is another of the cereal grasses, and in botany is placed in the 3rd Class, *Triandria*, the 2nd Order, *Digynia*, and the genus *Hordeum*, in the Linnæan system; in the natural order *Gramineæ* of Jussieu; and Endogens of Lindley. It is divided into two species, namely, the two-rowed and the six-rowed.

The history of barley, like that of wheat, has, by the mystification of the learned, been

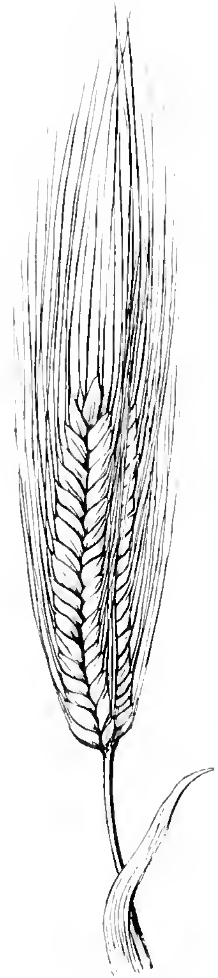
SHERRIFF'S BEARDED RED WHEAT.



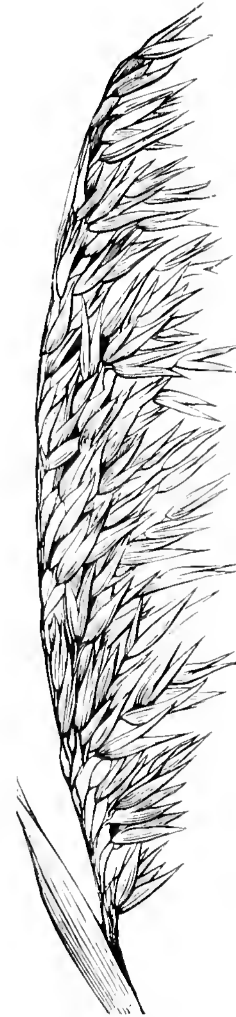
BANGHOLM BARLEY.



COMMON OAT.



SIX-ROWED BARLEY.



TARTAREAN OAT.

involved in obscurity, but may also be at once referred to the original creation of the cerealia. It is unnecessary to refer to the Holy Scriptures for the solution of the question, further than again to state that "barley harvest" is mentioned at an early period of the sacred history, and that it was cultivated by the Egyptians, who were the first, according to Herodotus, who invented brewing from barley. "The Egyptians," he says, "having lost their vines, made wine from barley." This grain and oats were found by Colonel Chesney on the banks of the Euphrates in a wild state, from which it has been inferred that that country was the native land of those plants; but it is far more probable that they were the vestiges of a long bygone civilisation, under which those and other cereal plants were cultivated by the inhabitants.

Barley, as a cultivated plant, has a much greater range of latitude than wheat. It is cultivated successfully in the Faroe Isles, under lat. 62° 15′ N.; in Western Lapland under 70°; on the shores of the White Sea under 67° and 68°; in Siberia under 58° and 59°, &c. It has followed or accompanied civilisation wherever it has penetrated, except in those parts where physical obstacles have rendered it impossible. The temperature required for its successful cultivation in this country is about 46° Fahr.; yet in Iceland, where the average temperature in summer is about 47°, no cereal plant can be raised, on account of the continual fall of rain. In England it has been cultivated from time immemorial, and was formerly used extensively as bread-corn, but has almost entirely given place to wheaten bread, which is now consumed by every class. In Scotland barley is still commonly eaten, especially in the Lowlands, where, mixed with oatmeal, it is made into cakes (called *bannocks of barley*) and is also employed in "*parritch*," in which form it is much esteemed by all classes. The northern nations of Europe also consume large quantities of barley.

The use of barley in England is almost wholly confined to the purposes of brewing and distilling, and the quantity disposed of annually in this way is enormous. The following are the official returns of the quantities of malt and spirits entered and retained for consumption, in the years stated, in the United Kingdom:—

Years.	Malt—bushels.	Spirit—gallons.
1844	37,187,186	20,608,525
1849	38 935,460	22,762,012
1854	36,812,767	25,883 584
1858	45,105,773	23,212,612

During these fifteen years the increase of the population has not been more than 1,000,000, a loss of 2,000,000 having been sustained in Ireland at the census of 1851, by famine, fever, and emigration, without any subsequent increase; whilst the consumption of malt has been increased nearly 8,000,000 bushels, or 21 per cent., and that of spirits 2,604,087 gallons, or about 12½ per cent., but the increase of the population does not amount to 4 per cent. This increase in the consumption of spirits is especially to be deplored, it being admitted by all the authorities that nine-tenths of the crimes committed in England are attributable to intoxication—the vice of drinking spirits and other alcoholic liquors. While, however, the revenue from this baneful source continues so large, it will be in vain to look for any legislative measures to abate the evil. The farmers, too, generally look upon distillation from barley as beneficial to them by securing to them a ready market for that product. It can, however, be shown that in every way they would be benefited much more by consuming the barley on their farms in fattening cattle. It has been calculated that when a labouring man spends a shilling at the public-house, not more than one penny of it goes to the farmer for the barley; but that if he spends the same sum with the butcher or baker, nearly the whole amount goes to the farmer for the raw material, and only a fraction to the tradesman for profit. If we take into consideration, also, the injury done to the constitution, and the consequent diminution of physical strength of the habitual drinker, and the heavy expense it entails upon the land in the increase of poor's rates, county rates, and other ways, we are justified in saying that the distillation of spirits is as great a curse to the farmer in a pecuniary sense as it is to the drunkard and the community in a moral one. Upwards of £60,000,000 per year is spent in strong drinks in the United Kingdom, of which about £15,000,000 or one-fourth, goes to the government, which, therefore, cannot afford to be moral, and a great part of the other three-fourths to the distiller and the publican.

Even apart from the moral side of the question it is a short-sighted policy, both in the government and the barley grower, that continues to encourage the manufacture, and thereby the drinking, of spirituous liquors for the sake of revenue. "The labouring man who spends part of his earnings at the public-house lessens to that extent both his physical ability to labour, and his pecuniary means of purchasing wholesome food and good clothing. By the first his employer suffers; by the second the man himself, his family, and the tradesman of whom he would otherwise make useful purchases; and by both the community at large is injured. A correct calculation, therefore, will show that spirits and malt liquors are the very worst forms for the farmer in which his grain can be consumed. Were the £60,000,000 now annually spent upon them employed in purchasing bread, meat, and other wholesome food, and woollen and linen clothing, the farmers would, on the one hand, be relieved from a great part of the rates that now oppress them; and, on the other, have such an increased demand for their staple products as would more than compensate for the closing of what is at present the chief outlet for their barley." *

The following are the principal varieties of barley cultivated in the United Kingdom:—

Hordeum distichum.	1. The Common English barley.
	2. The Chevalier barley.
	3. The Annat barley.
	4. The Noble barley.
	5. The Moldavian barley.
	6. The Potter's barley.
	7. The Black barley.
	8. The Battledore barley.
Hordeum hexastichum	9. The Common bere.
	10. The Victoria bere.
	11. The Siberian, or Naked bere.

Of the first eight, the Common, the Chevalier, the Moldavian, the Black, and the Potter's barley are principally cultivated in England, whilst the Annat and the Noble varieties, and the three species of *Hordeum hexastichum*, or bere, are grown in Scotland and Ireland.

The Common English barley has been cultivated from time immemorial, and still stands its ground against all new varieties. The finest types of this, as well as of other

* Morton.

kinds, are produced in the counties of Norfolk and Suffolk, which are *par excellence* barley districts, although the Kentish barley is found to yield a rather larger proportion of malt. It is probable that barley was introduced into England by the Romans, who cultivated it for their horses and cattle; but very little is known of the early history of this plant. The Common barley is too tender to stand the winter in even our comparatively mild climate, nor will a very rich soil produce a good quality, owing to the too great luxuriance thereby produced. A light, warm, friable soil of moderate fertility, well tilled, and early sowing, are the conditions most likely to prevent this, and to ensure a good return.

2. The Chevalier barley is an accidental variety, and was raised from a single ear, found by a gentleman whose name it bears, in a field of the common kind. The straw is full and strong, and less liable to be lodged than any other kind. The grain is short and plump, the skin thin, and it weighs from 52 lbs. to 56 lbs. per bushel. It is a good yielding plant, under careful cultivation, and where the land is drained; it also admits of being sown early. It is highly esteemed by the maltsters, and is now, on that account, generally cultivated throughout the kingdom.

3. The Annat barley is cultivated in Scotland, where it is found very productive, and ripens earlier than other kinds. The grain is longer and less plump than the Chevalier, and it is, therefore, less sought after by the maltster, and bears a lower value at market.

4. The Noble barley takes its name from that of the person who first established the variety. It is a recent production, and is at present but little known or cultivated.

5. The Moldavian barley was introduced about seventy years since, when a small quantity of it was imported into London and sold for seed at four guineas per bushel. The father of the writer purchased half a peck of it, which he planted in single grains; and from the produce of this, in the second year, he sowed his whole crop of about 100 acres, and sold a considerable quantity for seed to his neighbours. It is a very productive variety, is strong in the straw, the ear $3\frac{1}{2}$ inches to 4 inches long, the grain rather large and full, and possessing excellent malting qualities. This variety still holds its ground in Norfolk and Suffolk, being found profitable to the maltster as well as to the farmer.

6. Potter's barley was first cultivated by Mr. Potter, of Hundon, in Suffolk, who procured a wine-glass full of the seed from a vessel lying in the river at Ipswich. It came from Zealand, and has proved a very useful variety, so that it is generally cultivated in the county and neighbourhood where it was first introduced. It weighs from 52 lbs. to 56 lbs. per bushel, malts well, and admits of early sowing. It has been tried in Scotland and the north of England, and has succeeded well, producing abundant crops.

7. Black barley is a variety of little value as an agricultural plant, either to the farmer or the maltster. It has long been known in England, but a few years ago there was an importation of it from Canada as seed-corn, the owner of which, in a written communication, stated that "it was raised from a single seed found in the crop of a wild goose that was shot on one of the lakes." This announcement, though imparting no intrinsic value, appears to have excited attention from some at least of the farmers, and the shipment was sold for seed. It was found, however, that in this case, at least, they should have "let well alone." The variety was inferior in every respect,

as well as in colour, to the kinds cultivated, and the Goose barley has disappeared. The straw is bulky, the grain coarse and large, and it ripens late.

8. The Battledore barley has a short ear, very wide at the lower end, and tapering to a point at the upper. The grain is coarse, and the straw is short. It is very little cultivated.

9. The Common *bere,* or *big,* has a short, broad, thick ear, with two single and two double rows of grain round the *rachis.* The grains are not so large as those of barley (proper), but it is much cultivated in Scotland, being hardy and productive, and it ripens rapidly. The skin is thicker than that of barley, and consequently it does not malt well, and is chiefly used for grinding purposes.

10. The Victoria bere is a new variety of the *Hordeum hexastichum,* and is much superior to the Common bere. The straw is longer, and the grain more prolific; the ear is four inches long, and contains from fifty to fifty-three grains of a finer quality than the Common bere, and weighing 56 lbs. per bushel.

11. The Siberian, or Naked bere, is six-rowed generally, but there is a four-rowed variety of it, which appears to have been a "sport" from the six-rowed. It differs from the Common bere in its seeds separating from the husk in threshing, which increases the weight of the grain so that it frequently attains 66 lbs. per bushel. It is used entirely for grinding into flour, and when mxied with an equal quantity of wheaten flour makes bread said to be superior to all wheaten bread, and one-fifth more in quantity from a given weight of flour. The bread also made from it retains its moisture and freshness four times as long as that from all wheaten flour. It is also used in making "porritch and bannocks," and for thickening soups, &c.

In choosing seed barley for a cold moist soil, care should be taken to select it from a warm and dry one, it being found by experiment that it ripens a fortnight earlier than seed grown on the same land. This is well known to the Scottish Lowland farmers, who generally purchase their seed barley fresh every year, otherwise it will degenerate again in a very few seasons. The same effect will take place on the light lands if the seed is not changed every year, or at least very frequently.

We will here give an account of a new variety of barley which has not, that we know of, yet received any name, but which was procured under such singular circumstances as to demand a notice. The circumstances were as follows:—In the summer of 1856 Mr. John Ekins, of Bluntisham, in Huntingdonshire, sowed some oats in his garden in the beginning of June. It should be premised that this was done by way of experiment, to test the truth of the transmutation of oats into rye, which, it is affirmed, has frequently taken place under particular treatment. The plants were cut down when they had attained about one foot of height, and this was repeated thrice, after which, as the weather became cold, and they no longer grew rapidly, they were left to stand the winter. Those which survived till the spring threw out fresh tillers, and at the proper time shot forth ears, but, to the astonishment of the experimenter, neither of rye nor oats, but barley. The produce was sown the next spring, and produced the same grain, but of a better quality; and since that period so superior has the variety proved, and so much esteemed by the maltsters, that it has been adopted generally by the farmers in the neighbourhood, who are satisfied both with the quality and the yield. We have now a sample of this barley before us, which is pronounced by a corn-factor to be of excellent malting quality.

The doctrine of the transmutation of species in plants, although repudiated by the generality of naturalists as contrary to all rational science, yet has been proved true by so many experiments as to set all doubts at defiance. The two instances we have already stated in the case of wheat are of this nature; and this one of oats transformed into barley is not more wonderful, the two plants being of the same natural order. The following remarks by Dr. Keissenborne, a German naturalist, are confirmatory of the truth of the doctrine:—

"With reference to the transmutation of oats into rye, this remarkable phenomenon has not only been verified by new experiments, but we have caused beds to be sown with oats, in order that we may be able to silence disbelievers by producing rye stalks which have sprung from the crown that still shows the withered leaves of the oat plant of the previous year. I repeat that this transformation does take place (about midsummer), the plants being cut twice (or thrice) as green fodder before shooting into the ear; the consequence of which is, that a considerable number of oat plants do not die in the course of the winter, but are changed in the following spring into rye, forming stalks that cannot be known from those of the finest rye. The Society (agricultural) of Coburg takes credit to itself for perseverance in having struggled against the opinion of the public for several years, in order to establish a fact which no physiologist would believe, because people are always apt to confound the laws of nature with those of their own system."

SECTION III.

OATS.

Avena is the botanical name for the oat plant, which is the third of the cereal grasses in point of importance to English agriculture. It is the native of a northern climate, and does not succeed even in the lower latitudes of the temperate zone; at the same time it is strictly an annual, and cannot stand the frost of a severe winter. The best qualities are produced in Scotland and Friesland, and in both these countries the oat is extensively cultivated, and forms a considerable portion of the food of the inhabitants. A rich loamy soil with a mixture of sand is the description of land best adapted to this plant. There is no doubt that although the oat has been cultivated for many centuries in England, it was originally brought thither from the Low Countries, and other parts of northern Europe, and has long become indigenous with us. Whether the wild oat is the parent of the cultivated one it is impossible now to determine, but it is probable that with attention it might be so improved as to form a variety equal to some at present in use. This, however, is quite an unnecessary experiment, there being no probability of producing any important improvement in it to render it desirable to substitute it for the present varieties.

Be this, however, as it may, the wild oat is a very troublesome plant to the farmer, and is certainly indigenous in England. Its vital principle is so strong that it will lie dormant for ages, retaining its power of vegetation. A friend of the writer's recently brought to the surface of a field that had long been cultivated, the *subsoil, which had never before been disturbed;* the consequence was that the wild oat, which had not before appeared in any troublesome shape, came up in such abundance as to materially damage the wheat crop that was sown on the field. It is a fact that seeds of the wild oats found at Herculaneum, and which had been buried seventeen centuries, being brought to this country, were found to grow freely upon being planted. This is to be ascribed to the exclusion of the air, which, as is well known by naturalists, by preventing vegetation, at the same time preserves the vitality of the seed.

Botanists have arranged the natural classification of oats by the form of the ear. One kind has branches spreading equally all round the *rachis*, only growing gradually shorter towards the apex, thus forming a conical figure. The Potato oat is of this kind, as well as all those varieties used for making oatmeal in Scotland. The Potato oat is a tender plant, and the panicle has a weak hold on the stalk, so that when ripe the seed is apt to shake out of the capsule if agitated by the wind. A second kind of oat has an ear with shorter panicles, nearly of equal length, and pendant all on the same side of the *rachis*. These are called Tartarean oats, probably because they were originally brought from Tartary. This is a hardy plant and thrives in almost any soil or climate where no other cereal plant will exist. It is much cultivated in England for horses' food, but is too coarse a grain for making oatmeal; it is, therefore, not cultivated in Scotland, where only the best types of the plant are preferred.

The history of the Potato oat states that it was first discovered on a dunghill amongst some potatoes that had sprung up spontaneously like itself, which gave it the name. It requires good land, on which the grain will be large, plump, and round. The weight ranges from 40 lbs. to 46 lbs. per bushel, and sometimes produces 80 bushels per acre, and probably averages between 50 and 60 bushels. Oats are found on analysis to contain 7 per cent. of oily matter, and 17 per cent. of *avenine*, a protein compound similar to the gluten of wheat, thus containing fully 24 per cent. of really nutritious matter, capable of supporting the loss occasioned by labour from the fibrous portion of the body. Oats are invariably kiln-dried before they can be ground into meal, which causes the husk to separate more easily from the flour under the stones. In making groats the stones are set wide asunder. The fine meal is made into *bannocks* or cakes in Scotland, and the coarse is used for *porritch*. In Lancashire, oats are as much consumed as in Scotland amongst the working population.

There are about forty distinct varieties of oats, but the most commonly cultivated are the black, the long-bearded, the white, the red, and the naked oat. This grain contains only a very small portion of saccharine, and it is, therefore, of no use to the maltster or the brewer, although it was formerly employed in making a drink called *mum*. We never hear of this liquor now, the superiority of beer and ale having driven it out of the consumption of the country.

In choosing seed-oats it is necessary to avoid a sample in which there are many double oats, or where a large and a small grain are united. This is caused by three things; first, by being sown too frequently on the same kind of land; secondly, by being sown too thickly; and thirdly, by the ground being too rank.* Double oats are one-sixth or one-seventh lighter than single, which alone determines the quality to

* Varlo's "New System of Husbandry," vol. iii. p. 207.

be inferior. On wet, cold land the Potato oats are apt to ripen at the top of the ear, whilst the lower part is green. It is necessary in that case to cut them as soon as the first are ripe, otherwise, if they stand till the whole are ripe, half the crop will be lost by shedding. It is probable that the Potato oat was an accidental variety of the Poland oat, which in many respects it resembles.

Oats, with rye and barley, were the common food of the labouring classes so lately as the beginning of the eighteenth century, and in Cumberland towards the middle of that age wheaten bread was only used by the rich, and by them only at Christmas.* A "thick oat cake (called haver-bannock) and butter" was the only treat prepared for a stranger. At present, as we have already observed, it is the principal food of the working class in Scotland, and the result proves it to be highly nourishing, for finer and more stalwart or enduring men are not to be found in the United Kingdom than the Scotch. Fully one-fifth of the arable land of Scotland is employed in the culture of oats. Experiments were made in 1817 and 1818 by Mr. Mitchell, of Wester Alves, Elgin, to ascertain the comparative productiveness of oats, and from the results he drew the following conclusions:—

1st. That land pastured for two years gives a quarter of oats per acre more than land that has been cut for hay, when in first year's grass, and pastured the second.

2nd. That there is a decided loss of nearly 4 bushels per acre in taking seed oats, however good the sample, from a *later* to an *earlier* soil.

3rd. That there is an advantage in taking seed oats from a more southern and well cultivated district, as shown in the comparison of two samples of late Angus oats, the changed seed giving $\frac{3}{4}$ bushel more grain, and 38 stones more straw, per acre.

4th. That where a fine sample of grain, together with a large return, is desired, the Potato oat should be sown.

5th. That where straw and quantity of grain, without regard to *quality* are desired, the late Angus oat is to be preferred.

6th. That although the Dun oat has proved the most prolific in grain, it is of a coarse quality, and deficient in straw.

7th. That the Sandy, Berlie, and Early Angus, are nearly alike in their properties, the two former having the greatest weight of straw, and the last the largest quantity of grain.

8th. That the Siberian oat has produced the heaviest sample of grain, but is inferior in its conjoined properties to the Potato, Early Angus, Sandy, or Berlie.

9th. That the Hopetown oat is the most unsuitable of all the varieties experimented upon.

The following were the experiments referred to:—

OATS GROWN IN 1817 AFTER TWO YEARS' PASTURE.

	Good grain. Bshls.	Light grain. bshls.	Weight per bshl. lbs.	Light grain per bshl. lbs.	Straw, chaff, &c. st.	lbs.
Sandy oat per acre	$55\frac{1}{4}$	$3\frac{1}{2}$	43	38	314	8
Berlie ,,	$47\frac{1}{4}$	$4\frac{1}{3}$	$43\frac{1}{2}$	38	272	6
Late Angus ,,	$55\frac{1}{4}$	$4\frac{1}{3}$	42	36	280	1
Hopetown ,,	57	$2\frac{3}{4}$	42	36	220	9

* Eden, vol. i. p. 502.

OATS GROWN IN 1848, AFTER TWO YEARS' OLD PASTURE.—$2\frac{1}{2}$ CWT. GUANO PER ACRE.

	Good grain. bshls.	Light grain. bshls.	Weight per bshl. lbs.	Light grain per bshl. lbs.	Straw, chaff, &c. st.	lbs.
Sandy oat per acre	$67\frac{3}{4}$	3	$43\frac{1}{2}$	40	376	8
Berlie ,,	$66\frac{3}{4}$	$2\frac{1}{2}$	43	40	364	8
Potato ,, from Mid-Lothian	$78\frac{1}{4}$	$1\frac{1}{4}$	$42\frac{1}{2}$	39	343	0
Early Siberian oat per acre	71	$2\frac{1}{4}$	45	41	292	6
Early Angus ,,	73	$2\frac{1}{4}$	$43\frac{1}{2}$	40	315	9
Dun ,,	$79\frac{3}{4}$	2	42	39	331	8
Late Angus ,,	$75\frac{1}{2}$	3	41	37	410	4
Do. seed grown on the farm	$74\frac{3}{4}$	4	$41\frac{1}{2}$	38	372	8
Hopetown ,,	$62\frac{1}{2}$	$2\frac{1}{4}$	$42\frac{1}{2}$	37	328	5*

The Potato oat has been getting out of repute for some years on strong wet land, on account of its tendency to become "tulip-rooted" and sedgy-leafed. But on rich, well cultivated soils, it is still the favourite oat, producing the greatest quantity of best corn, and the greatest weight of meal from the quarter of oats. Much, however, depends upon the nature, condition, and tillage of the soil. Neither a strong clay, nor a light sandy soil, is suitable for the Potato oat. Several other varieties cultivated in Scotland appear to yield a greater produce; but none are of better quality, or yield, weight for weight of grain, or larger proportion of meal. The following list of the varieties of oats cultivated is also taken from "Morton's Cyclopædia:"—

Avena sativa.—(White Species.)

1. Potato.
2. Sandy.
3. Hopetown.
4. Early Angus.
5. Sherriffe.
6. English berlie.
7. Scotch do.
8. Barbachlan.
9. Cumberland early.
10. Friesland.
11. Old Poland.
12. Davison's.
13. Flemish.
14. Kildrummie.
15. Siberian.
16. Strathallan.
17. Late Angus.
18. Grey do.
19. Drummond.
20. Cupar.
21. Blainslie.
22. Georgian.
23. Early Kent.
24. New early Essex.
25. Blue mayor.
26. Marble hill.
27. London dun.
28. Danish.
29. Three grained.
30. Argyleshire.
31. Cleveland.
32. Lancashire.
33. Tuscany.
34. Chandos.
35. Hangingside.

Avena sativa.—(Black Species).

36. Old black.
37. Common dun.
38. Winter dun.
39. Archangel.
40. Red Essex.
41. Orleans early brown.

Avena Orientalis.

42. Common white tartar.
43. Early do.
44. Early black do.

Avena fatua, or Wild oat.

45. Common wild.
46. Market bearded.

Avena brevis.

47. Short oat.

Avena nuda, or Naked oat.

48. Common naked.
49. Small do.

Danthonia strigosa.

50. Bristle pointed.

Avena sterilis.

51. Animal or fly.

With regard to the proper time for sowing oats there is a difference of opinion; but from experiments that have been instituted, it would appear that early sowing, if the winter proves not too severe, will best ensure a heavy crop. In Kent and Essex the farmers usually sow as early as the Christmas week, if the land is in proper condition; and they find that they obtain a more abundant crop than if they defer it till March

* The above is taken from Morton's "Cyclopædia of Agriculture."

or April. In an experiment made some years ago by the Earl of Winchilsea, in which four acres of a field were sown the day after Christmas Day, and the remaining four acres in March, the early sown were ripe a week before the others, and the produce respectively was—

Early sown	11 quarters per acre.	
Late sown	9 „	4 bushels per acre.

The weight per bushel (Winchester) when threshed, was—

Early sown	$44\frac{1}{2}$ lbs.
Late sown	$42\frac{1}{2}$ „

The early sown, therefore, had the advantage of the late to the extent of 12 bushels in measure, and of 686 lbs. in weight. Five bushels of seed per acre were sown on both portions of the field. Although an annual plant, the oat is more hardy than the Common barley, and will survive a moderate degree of frost, if the land is drained, or otherwise free from stagnant water in the soil. It is, therefore, desirable to get the seed in as soon after Christmas as the state of the land and the weather will allow; and none ought to be sown after the middle of March, if it can be avoided. This applies to the midland and eastern districts of the kingdom, but not to the northern, where the winters are more severe.

It is usual to sow from three to five, and even six bushels of seed oats per acre, but such a seeding appears to be very inconsistent with the nature of the plant. The oat will tiller as well and as much as any of the cereal grasses; and, consequently, requires room to develop itself, which it will do to an enormous extent. The writer recently took a plant of oats, when ripe, out of a field where it had plenty of room; and on rubbing out the grain found there were 5,000 the number of stalks being between forty and fifty.

SECTION IV.

RYE.

Secale cereale is the botanical name of this plant, of which there are four varieties recognised, namely—*Secale velossum, Secale orientale, Secale creticum, and Secale cereale proper*. This last is the only one planted in the United Kingdom, and that not generally for the purpose of producing human food, but to be eaten in a green state by horses and cattle. It must, however, be consumed before it spindles for earing; otherwise, it is neither palateable nor beneficial to the animals, which are *compelled* to eat it, for they will not do so unless pressed by hunger and can get no other food. Formerly, it was the custom in this country, as it is still on the continent, to sow wheat and rye together, which mixture, when harvested and threshed, was called *Meslin,* from the word *miscellanea.* Being a good deal cultivated by the monks, it was thence called by the country-people Mung-corn, or Monk corn; and in the year 1800, when the high price and scarcity of wheat compelled the labouring class to eat barley bread, it was called by them *barley-mung*, a traditional relic of the "olden times."

After wheat, rye contains the largest portion of gluten of any of the cereal plants. It also contains five per cent. of saccharine matter, ready formed, and malts readily; but barley is so superior in this respect, that it has quite superseded rye-malt. It has a tendency in distilling, to pass rapidly from the vinous to the acetous fermentation; and when this takes place it can be neither brewed nor distilled. Rye in its normal state, but ground into meal, is mixed with barley-malt in Holland, in the proportion of two parts of the meal to one of malt. This mixture being fermented together, forms the wash from which is distilled the Hollands Geneva for which that country is celebrated. The juniper berry is added to give it the peculiar flavour for which it is noted and esteemed.

Some years ago rye came into much use as a substitute for coffee, and the then celebrated radical reformer, Hunt, derived a large income for a time from its manufacture, which only consisted in roasting the grain in the same way as is practised with coffee. At that time the duty on this latter was very heavy, and the cheapness of the substitute obtained for it an enormous consumption. Even, however, before the reduction of the duty, the "Hunt's coffee" went greatly out of repute, and after that reduction took place it was no more heard of.

Rye is still the common food of a large portion of the populations of northern Europe. It is extensively cultivated in Prussia on the sandy plains bordering on the Baltic and the Russian provinces on the Gulf of Finland. In Sweden and Lapland it is a common custom to sow rye and barley together as soon as the land can be prepared in the spring. The barley shoots up first, and, covering the ground, retards the growth of the rye, until the former is ripe and reaped, when the rye takes its turn in covering the ground; and without any further care or preparation from the farmer, yields an abundant crop the next summer.

Rye is subject to a disease called "the ergot," which renders it noxious and unwholesome as human food. It is called *horned rye* in England, the grain bearing an excrescence similar to a cock's spur, from which circumstance the French name of *ergot* is derived. There are various theories to account for this singular form of vegetable disease, which, from some experiments, appears to be conveyed by its sporules like all other fungoid plants, to which it has an affinity. According to Dr. Latham, other grasses besides rye are subject to the ergot, and when thus diseased, are unwholesome for the cattle. Bread made of the diseased rye has an acrid and disagreeable taste, and its use is followed by spasmodic symptoms and gangrenous disorders. In 1596 an epidemic prevailed in Hesse, which was wholly ascribed to the use of *horned* rye. Some who had partaken of it were seized with epilepsy, which usually ended fatally. Of others, who became insane, few ever wholly recovered the use of their senses; whilst those, who were apparently restored, were liable through life to periodical returns of their disorder.

These effects have, at various periods, been repeated on the continent in different parts. In France, in 1709, in consequence of the diseased condition of the rye, no fewer than 500 patients were, at one time, in the public hospital at Orleans. The symptoms at first had the appearance of drunkenness, after which the toes became diseased, mortified, and fell off. Then the leg became the seat of the disorder, and frequently after amputating the limb, the trunk was attacked, which speedily produced death. All animals, on partaking of this pernicious substance, experience its deleterious effects. Deer, sheep, swine, poultry, upon eating it, have died miserable deaths. It is fortunate for this country that the population are no longer subject to such a calamity. It is probable that it may be superinduced by defective methods of cultivation; but, however this may be, even where rye is grown in England, the ergot is very rare.

Rye, as spring feeding, is valuable for milch cows, and especially for early lambs, as it makes abundance of milk in either case; when, therefore, these latter are reared for market, it is desirable to have a piece of rye for the ewes; to feed them on the land if the soil is sandy and dry, or cutting it for them if otherwise. This is the only use to which rye can be profitably put in this country. For the same purpose it is frequently sown with winter tares, the growth of which is promoted by it. It is said that green rye will cure sheep of the rot, if they are not too far gone in the disease. In the United States it is cut when the ear is shooting forth, and made into hay; but this must not be delayed till the ear is fully out.

SECTION V.

MAIZE.

This plant has never been acclimatised in this country; but, at the beginning of the present century, the celebrated William Cobbett made some attempts to introduce its culture, and to induce the British farmer to adopt it. Many of his admirers, putting full faith in his judgment and honesty, made the attempt, but it proved a miserable failure; probably from the variety that was used not being adapted to the climate, or sufficient time not being allowed to naturalise the plant. We recollect seeing a field of "Cobbett's corn" growing in Norfolk at Michaelmas, when it ought to have been ripe, as the summer had been favourable. Instead of which, the ear was scarcely formed; and, if we recollect right, it never did ripen, but was thrown into the straw-yard for the young cattle. The only kind that can be cultivated as a field-crop to any advantage, and under any circumstances in England, is the German maize, a small kind of plant which admits of early planting, and arrives at maturity in October. In America there are many varieties, but the Mohawk, a short kind, is sown so late as June, and ripens in October.

Nevertheless, we believe it still possible to acclimatise this valuable plant so far as that, by sowing it in the first instance on a seed-bed, protected from the late frosts, and transplanted in the beginning of May, it may, in a good season, be brought to maturity by the close of the regular harvest. It is a question, however, whether the produce would be such as to make it an object of importance in a pecuniary point of view, to raise a description of corn that can now be imported from America and some parts of the European continent, at so low a price. It is only in exceptional years that it can be brought to perfection with us, but it probably would be useful as fodder for cattle. The stalk contains as large a proportion of saccharine matter as the sugar-cane of the West Indies, and the cattle are extremely fond of it. It yields a large quantity of food, and is more palatable when approaching maturity than in the early stage of its growth.

Maize is much cultivated in the south of France and in Italy. May is the usual month for planting it ; but in Languedoc they cultivate the "forty days" maize, which is planted after the wheat-crop is reaped and arrives at maturity the same season. It is principally used in fattening fowls, of which an enormous number, turkeys, capons, &c., are kept in the south of France. There are three varieties of this maize, the grain of all being very small, and the yield per acre very insignificant, compared with the larger grained varieties.

The use of maize was introduced into Ireland in 1847, during the famine; but so prejudiced were the peasantry against it, that nothing could persuade them to eat it. A clergyman endeavoured to adopt it in his family instead of potatoes; but such was the dislike of the servants, that upon his endeavouring to enforce its use, they poisoned the whole family. One fine young man died from the effects, but medical assistance being called in, the rest were saved. The girl who was known to have mixed the poison with the food, was put upon her trial ; but, as is frequently the case, the jury acquitted her, although the proofs of her guilt were undoubted. So much, however, has the taste of the Irish changed since that time, that they now prefer the Indian meal to oatmeal, and a large quantity of it is annually consumed

SECTION VI.

BUCK-WHEAT, OR BRANK.

The botanical name of this plant is *Polygonum fagopyrum* (Smith), or *Fagopyrum esculentum* (Moench). It is called beech-wheat by the Germans, because the seed resembles the mast of the beech-tree in its shape. It flourishes on a light sandy soil, and is cultivated on such land in Norfolk, but not to the same extent as formerly. It is frequently grown for manure, being in that case ploughed in as soon as it comes into flower. The land is then left for the buck-wheat to decay before it is again ploughed up to be sown with wheat.

Buck-wheat is also useful as fodder in the green state, all animals being fond of it. It is an excellent food for milch cows, causing them to yield abundance of rich milk, and good flavoured butter and cheese. It resists the drought better than any fodder plant, and maintains its green hue when the upland pastures are scorched. The ripe seed is used in fattening fowls, who eat it eagerly. It is also employed largely in feeding pheasants in preserves during the winter. It is sometimes sown in fields bordering on the plantations, in order that the game may help themselves, as well as to afford them shelter. It is, however, more frequently preserved in the straw, and given to them in that state when, the acorns and other natural food of the pheasants gets scanty.

Most animals are fond of the seed of buck-wheat, but it ought to be crushed before it is given to them; otherwise, being a small hard seed, it is apt to pass through them whole. Pigs are excessively fond of it, but are liable to become intoxicated if too much is given to them at a time. But, like tobacco with the human species, this effect ceases when they become habituated to it, and they fatten fast upon it. On the continent, buck-wheat is used in distillation, and it yields a good proportion of excellent spirit. At the Prussian ports on the Baltic coast, this application of it is very general; and large quantities are raised for the purpose upon the arid soils prevailing along the southern shores of that sea, which are suitable to its culture. It is also eaten as bread, when mixed with rye and oats, by the rural peasantry of Prussia and other northern states.

Buck-wheat, like tares, peas, and beans, derives the chief part of its nourishment from the air, and improves rather than impoverishes the soil, by affording it shade without exhaustion, during the heats of summer. It was first introduced into western Europe (France) by the Saracens from Africa; and was soon after brought to England. The flowers supply the bees with abundance of honey, at a time when the flowering trees and shrubs, and the meadows, have passed the blooming. In a favourable season two crops of buck-wheat have been obtained from the same land, but the first crop was sown early.

SECTION VII.

THE BEAN.

The botanical name of the bean is *Faba vulgaris*, and it is considered to be of Asiatic origin, being mentioned in Scripture as having been presented to David at the time he was fleeing from Absalom. The seed of the bean is *dicotyledonous*, and, when ripe and hardened, the cotyledons are cemented together by an albuminous substance, so that it is difficult to separate them from each other. The husk is very tough, and the germ is situated under the eye of the seed, being protected securely from injury by the husk, which is hardest at that point. In the process of vegetation, the cotyledons form the appearance of leaves when the germ pushes upwards; but when that becomes fully developed, and shoots out other foliage, they drop off.

There are two distinct classes of beans, namely, the *Faba vulgaris arvensis*, or Field bean, and the *Faba vulgaris hortensis*, or Garden bean. Of the former there are nine varieties cultivated :—

1. The Common Horse-bean.
2. The Tick.
3. The Heligoland.
4. The Pigeon.
5. The Purple Field.
6. The Russian or Winter.
7. The Amfield Field.
8. The Early Mazagan.
9. The Long Pod.

The common Horse-bean is much cultivated in Scotland, being a hardy and prolific plant, yielding in a good season 30 bushels per acre, weighing from 60 lbs. to 66 lbs.

per bushel, according to the dryness of the grain. It thrives best on a strong soil, being apt to run to straw if the soil is loose and rich; whilst on a light sandy soil the produce is poor. The proportion of nutritive matter and husk is eighty-two per cent. of the former, and eighteen per cent. of the latter, and loss. The common bean is frequently mixed by millers, in a small proportion, with wheat in grinding, it being considered to give strength to the flour, without injuring either the colour or the flavour.

The Common Tick bean is more cultivated in England, and is used as horse-feed. The grain is one-third smaller than that of the Scotch or Horse-bean, to which it bears, in other respects, sufficient affinity to lead to the conclusion that the one is a modification of the other. The proportions of kernel and husk are much the same, but the straw is shorter. It is adapted to a lighter soil, and is generally more prolific than the preceding. There are several varieties of the Tick, but they present too little difference to need enumeration or description.

The Heligoland bean is a hardy and an early plant, with a short straw. The seeds are small, round, and of a chocolate colour, the husk thick and hard; the kernel whitish, hard, and bearing a similar proportion with the skin as the Tick. On common soils the Heligoland bean is inferior to the Horse-bean in yield, and it requires a rich one to obtain from it a good return.

The Pigeon bean is the diminutive of the tribe, but it is an early and good yielding variety. The grains are dark and round, and the straw short. It is of German origin, and is extensively cultivated in that country. In the south of England it is sown as a winter bean in the autumn, in drills at wide intervals, which, in the ensuing summer, are planted with cabbages. The beans being ripe in July, the cabbages have room, after their removal, to mature themselves by October, the land thus yielding two crops in the year.

The Purple Field bean is much the same in character as the Heligoland, except that the husk is darker. The seeds are small and round, and the cotyledons are of a yellow colour. It is a late plant, and not over prolific. The straw is about four feet high, and the pods have four or five seeds each.

The Russian Winter Field bean is a plant cultivated in every portion of the United Kingdom, being the most hardy of all the varieties of beans. It is sown generally in October; and it is seldom that it is destroyed by a severe winter, unless the land is sodden with water from being undrained; otherwise it is the most profitable bean of any. As it ripens in July or the beginning of August, it affords ample time to prepare the land for wheat. It is less liable to the attacks of the bean-louse or *aphis* than any other of the bean tribe, which are frequently destroyed by it. It is well adapted to Ireland, and its cultivation in that country is annually increasing. The stalk of the Russian bean is about four feet high, the seeds rather smaller than those of the Scotch bean, and its weight per bushel from 66 lbs. to 70 lbs.

The Amfield bean is somewhat similar to the Early Mazagan, and is the largest of the field beans. The straw is from four to five feet high, the pods about four inches long, and containing three or four seeds of a flattish shape. It is suitable either for the field or the garden, but is not equal in productiveness to the smaller varieties of field beans.

The Early Mazagan was a native of western Africa, as its name would imply. The stalk is from four to five feet high, the pods contain four or five seeds, flat and dimpled on each side. It likes good rich land, and on such is very productive. In Scotland its cultivation is confined chiefly to the garden; but in England it is sown as a field crop as well as in the garden. It should be either dibbled or drilled in wide rows, and will bear to be sown as a winter bean if the season should not prove very severe.

The Long Pod bean is also cultivated either for the field or garden. An early variety has been recently introduced which is more prolific; it is called "Child's New Early Long Pod." It is stouter in the stalk and rather taller than the Common Long Pod or the Early Mazagan, and the seeds are larger by one-third. It is said that beans will vegetate as well, if not more strongly, lying on the bare ground, than when well covered with the soil. There is no doubt but that they will grow in that situation if the soil is moist; but it is a proof to the contrary of this proposition, that drilled beans produce a better crop than when they are sown broadcast.*

The produce of beans, like that of other grain crops, varies with the nature and condition of the soil in which they are grown, and the season. From 20 to 40 bushels and even 50 are reaped, and the average weight is estimated to be 66 lbs. per bushel. They are given to horses in a crushed state, and sometimes boiled; and they are not only grateful food to that animal, but they sustain his vigour under severe labour without exhaustion. From 3 lbs. to 6 lbs. of beans per day is a fair allowance for a horse in full work according to his size; but, being of a highly astringent nature, a more laxative food, as bran, should be given with them when a horse comes off a journey. The following, according to Einhoff, is the composition of the Field bean :—

Husk	10
Legumen, Albumen, &c.	11·7
Starch	50·1
Sugar, Gum, &c.	8·2
Oil and fat	0
Water	15·6
Salt and loss	4·4
	100·0

It is to the large proportion of *proteine* matters that beans owe their utility in supplying the waste of muscle in labour.

Beans, of one kind or another, are cultivated in almost every country in the world: Egypt is said to be the original one to which the world is indebted for them. Our first knowledge of the bean is derived from Greece, which owed its knowledge of agriculture to Egypt. In almost every country in the East the bean is used as an esculent, and in

* In the "Annals of Agriculture," vol. xxv., the following remarks are inserted by Mr. Vancouver:—"The land upon which peas or tares may be cultivated, does not require to possess so deep a staple as that appropriated to the culture of beans, the seed of which, in most soils, be their texture what it may, should never be deposited at a less depth than five or six inches below the settled surface of the ground. The necessity for placing the bean thus deep will appear very obvious to any one who will take the trouble to inspect the root of the bean, when the bean has attained to its full growth, and its seed to its complete maturity. It will then appear evident, that from the point where the seed was deposited in the ground it sends downwards a long tap-root, and upwards a thick strong one. Along this upper division of the root, lateral fibres are detached from the seed to the surface of the ground, and are evidently destined to collect and convey nourishment to the plant. The long tap-root which descends perpendicularly, and to a great depth from the point where the seed was placed in the ground, *being perfectly clear of laterals*, will not be supposed to contribute but in a small degree, to the growth and subsistence of the plant. Hence the necessity of placing the bean at a proper depth in the ground, &c."

many parts of Africa it is an indigenous plant; from whence, also, the Moors conveyed some of the finest varieties into Spain, when they settled in that country. During the continuance of slavery in the West Indies, great quantities of horse-beans were exported to those islands, where they were consumed by the negroes. It is stated by King that the annual consumption of beans in the islands was 4,000,000 bushels, and of peas 7,000,000 bushels. The cultivation, therefore, of these leguminous plants must have been much greater than at present.

It was formerly the custom with many farmers to sow "blendings," that is, beans and peas together in the proportion of two of beans to one of peas. By this plan the beans served as a support to the peas, and prevented them from rotting on the ground in a wet season. On the other hand, the peas being a more covering crop than the beans, prevented the weeds from getting ahead, to the injury of the crop. This practice is now, we believe, quite obsolete, although it was a common opinion, that if you got a good crop of "blendings," you would be sure of a good crop of wheat after it. It is an excellent practice to take off the tops of the beans as soon as the blossom is set. This prevents the plant from exhausting itself by growing upwards, especially in a wet season, and throws the nourishment into the seed. It also hastens the maturity of the pods, and destroys the black *aphis*, which is so destructive.

THE GARDEN BEAN.

In the old works on gardening, only two or three species of beans are mentioned; but by means of hybridising these with each other, or with newly imported species, many varieties of this plant are now cultivated. As this work is devoted exclusively to agriculture as applied to the farm, we shall merely mention the principal kinds that are cultivated by the market gardeners for the supply of the metropolis, which are as follows:—

- The Early Mazagan.
- The Long Pod, with seven varieties.
- The Broad Windsor.
- The French, with many varieties.
- The Scarlet Runner.
- The Haricot.

Of these, the French bean and the Scarlet Runner are cooked and eaten in the husk whilst quite young and green; the rest being shelled whilst in a tender state, except the Haricot, which is used in the dry state after harvesting. Of the large kind of bean the Broad Windsor is the most cultivated and the most profitable; and from its ripening unequally, some pods being much advanced, whilst others are scarcely off flowering, they continue to yield a supply for the table for a considerable time. They will not stand the winter, and are usually sown from February to June, but the produce of the late sown is small. There are very few gardens in the United Kingdom in which this bean is not a standing article of produce.

Next to the Windsor is the Mazagan, which, in the garden, is much larger and finer than in the field. It is more hardy than the former, and is planted as a winter bean in October and November, and as a spring crop, at any time during that season. It comes forward earlier than the Windsor, and is very prolific.

The Long Pod bean in all its varieties is very productive, and being a late plant affords an agreeable variety in the autumnal list of table vegetables.

The French bean is well known from its productiveness and excellent qualities as an esculent. Its botanical generic name is *Phaseolus vulgaris*, and includes the Scarlet Runner and the Haricot. The *Scarlet Runner* is essentially the poor man's plant, being very prolific, and continuing to bear almost the whole summer. There are few cottage gardens in which it does not form a constant and principal article of produce. In France it is the custom to salt the French beans and keep them in sacks, till the winter, when they form an agreeable variety in the slender list of culinary vegetable food. It is rather extraordinary that this plan is not adopted with us. The *Haricot* bean is extensively cultivated in France and Italy, and great quantities are imported into the United Kingdom in the mature state. The seed is a small white bean, and when boiled is a delicious esculent at that season when vegetables are scarce, and few in number.

The common bean, although eaten exclusively by cattle and horses, contains ten per cent. more nutritive matter than wheat, the proportions being eighty-four to seventy-four per cent. This will account for its superiority as food for horses, enabling them to sustain the most severe labour either in the field or on the road.

SECTION VIII.

THE PEA.

The Pea (*Pesum sativum* of Linnæus), is another leguminous plant, and, like the Bean, is both a field and a garden production. Its history and native country are unknown, except that it has been cultivated in England for centuries before botany had, as a regular science, been introduced. Like the bean, too, it is cultivated as an esculent plant wherever civilisation has found its way. It is probable that the Common Pea, which gives the generic name to the family, was brought hither from the south of Europe. That it has long been a staple article of produce, both in England and Scotland, is proved by incidental mention of it in history on various occasions. Thus, at the close of the thirteenth century, the English forces were detained so long at the siege of a castle in Lothian, that, having exhausted all their provisions, they continued as a resource, to subsist on the peas and beans cultivated in the surrounding fields. Notwithstanding this fact, the garden pea does not appear to have been grown with us, for Queen Elizabeth was obliged to send over to Holland (according to Fuller), for a supply for her table. "Fit dainties," says the old chronicler, "for ladies, they come so far and cost so dear." And in the "Privy Purse" accounts of Henry VIII. is an entry to this effect:—"Paied to a man in rewarde for bringing pescods to the King's Grace iiij*s*. viii*d*." (£1 11*s*. 8*d*.) This appears the more strange, that, according to the burden of an old song made in the reign of Henry VI., peascods were sold in the streets of London :—

> "Then unto London I dyde me hye,
> Of all the land it bearyeth the pryse ;
> 'Gode pescodes,' one began to cry."

There are several varieties of Field peas, as the Maple Grey or Partridge pea, the White Boiling pea, the Blue pea, the Charlton or Forty Days' pea, the Winter pea, the Common Grey pea.

All kinds of peas love a light loose soil, deeply tilled and moderately rich. If the land is in too high a condition, the plants will run to straw too luxuriantly to produce a good crop of grain. There are two varieties of Grey peas, one of which is called *cold seed*, the other *hot seed*. The cold seed should be planted in February if the frost is out of the ground, and the soil is dry and properly tilled. This kind ripens slowly, and therefore requires more time for growing than the hot seed, which is not sown before the latter end of March or April, and yet is matured sooner than the other. The use of the Grey peas of both kinds is for fattening hogs, for which purpose they are superior to every other kind of food, the bacon from hogs so fed being solid, well-flavoured, and wasting little or none in boiling.

The White pea is either a garden or a field plant. In the latter form a considerable quantity is grown in those soils suitable to its nature. It is more tender than the Grey pea, but both will bear a certain degree of cold without injury. The White pea is apt to degenerate if sown on land unsuitable to it. In that case they do not "break," in boiling for soup, but remain whole, and are therefore said to be "good boilers, but bad breakers." A good pea for making soup dissolves when boiled in soft water, which is one of the essential conditions in cooking them properly. They are, as we have already stated, sometimes sown with beans, which act as sticks to support them; and they are easily separated, if required, after being threshed together, on account of the difference in size. Pea straw is useful as fodder for all animals if well harvested, but is easily damaged by wet weather. It yields a considerable quantity of potash when burned; a waggon-load of it is said to produce upwards of 100 lbs. of that substance. Excellent yeast may be made by taking a wine-glass full of split or bruised peas, and pouring over them a pint of boiling water. They must be covered over, and set on the hearth or any warm place all night. In the morning the water will have a froth on it, which is good yeast. Warmth is essential to its fermentation.

Of the Blue or Purple pea there are two varieties, the Australian and the American. The first has a *purple pod*, whilst the seeds are of a dun colour. It grows to five feet in length, and the pods generally grow in pairs. It is an early plant, and succeeds well on light soils and late districts. The American Purple pea reaches to four or five feet in length of straw, pods growing in pairs, and seeds dark purple, mottled with black spots. It is an early and very prolific variety.

The Charlton pea is supposed to have been the original of all the garden peas except such as have been imported from abroad of late years. It differs little from the White pea mentioned above, which is probably a variety of it.

The Winter pea has the straw about four feet long, and the seed is smaller than the spring varieties, and is of a dark colour. It is usually sown in October, and stands the severest winter without injury, ripening before any of the spring kinds. It is cultivated extensively in France and other parts of the continent, both as a winter and a spring plant.

The common Grey pea is much cultivated in Scotland, mixed with the Horse bean. It furnishes abundance of straw, and is thus serviceable at harvest in binding up the beans when cut, as they both ripen about the same time. Dry weather and light soil suit this crop, as they then do not run so much to straw. In a wet season, too, both straw and pods are liable to decay as they approach maturity. The pods fill well with six or eight seeds. It is a prolific plant, and when preserved by beans from the effects of rain, yields a large return. The straw is good fodder for cattle and sheep.

The yield of peas varies from 24 to 62 bushels per acre, but the latter is an exceptional produce. The range in Essex is from 32 to 48 bushels. Much, however, depends upon the season; for if that is unfavourable, the yield is reduced sometimes to from 12 to 20 bushels. No crop takes injury so soon, or to so great an extent, from a wet harvest as the pea. If ripe, the pods open with the rain, and shed their contents in a body, on the ground. We have seen nearly a whole crop thus shelled under a continued rain; and nothing can be done with them but to turn in the pigs and large fowls to consume them as they lie.

With regard to the comparative value of peas as an article of food, the quantity of nutritive matter in a crop of 25 bushels per acre is as follows:—

25 bushels = 1,600 lbs.

Husk	130	
Starch, Gum, &c. . .	800	
Gluten	380	
Oil or fat	34	
Saline matters . . .	48	
Other matters . . .	208	= 1,600 lbs.

The following is the comparative composition of pea and bean grain and meal:—

	Grain.			Meal.		
	Water.	Husk.	Meal.	Starch.	Legumin.	Gum, &c.
Peas	14·0	10·5	75·5	65	23	12
Beans . . .	15·5	16·2	68·3	69	19	12

The quantity of leguminous matter in these seeds accounts for their utility in supplying the waste of muscular matter in animals.*

In Germany it is not unusual to cover the field with straw after peas are sown. The peas shoot up through the straw, and between them the ground is soon so completely covered as to smother the weeds effectually, and the stems of the peas are prevented from rotting by contact with wet ground.

In Flanders, different kinds of corn are sometimes sown thickly together for a forage crop, as beans, peas, tares, barley, &c. These are cut as soon as they are off the bloom, and given to the live stock. It takes little from the soil, as no seed is formed, and the weeds are prevented from spreading by the thickness of the crop, and the land is in a good and clean state for wheat after the green crop is taken off.

Peas are much less cultivated than formerly, as well as beans. Not only has the demand for both ceased in the West Indies since the abolition of slavery, but their consumption in this country as food for the labouring classes has ceased. Formerly peas were made into "bannocks," and they were otherwise eaten in a variety of ways. As human food, their use now is confined to the making of soup and pease-pudding, both which are still favourite dishes with all classes, and are considered very nourishing food.

* Stephens' "Book of the Farm."

Upon the whole, peas are a very precarious crop, and seldom remunerate the farmer for the occupation of the land. It is true they are reckoned a good preparatory crop before wheat, because they do not exhaust the land; but their liability to be injured, if not destroyed, both before and after maturity, is a great drawback to their profitableness. They are seldom manured for, nor would they certainly pay for it, unless it be a dressing of gypsum, which appears to be more effective than any other kind.

SECTION IX.

VETCHES OR TARES.

The botanical name for this plant is *Vicia sativa;* and there are many varieties, but those most cultivated in the United Kingdom are distinguished by the ordinary names of "Winter" and "Spring tares." The difference between these, whatever it may be, is probably accidental, or effected by successful attempts at acclimatisation, by sowing in the autumn instead of the spring, by which a new variety has been produced. It is, however, a difficult matter, in purchasing seed-vetches to judge from the samplė, whether they are Winter or Spring tares; and the buyer must trust in a great measure to the representation and honour of the seller.

Next to clover, tares are the most valuable of our green crops, all descriptions of farming live stock being fond of them, and thriving well upon them. The winter tares afford abundance of succulent food before the grass is ready for the cattle; and the Spring tares are equally valuable after the pastures have been fed down, and the drought checks them from further luxuriance. The Winter tares will spring again after the first cutting if well managed, and bear a second crop if required. They draw little nourishment from the soil, and, like peas and beans, are an excellent preparatory crop for either turnips or wheat. If they are wanted in succession, they should be sown at different periods, so that one portion shall come in when another is finished. By sowing a large quantity at once, a part will get too forward before they are finished, and the cattle will reject them.

Almost any soil is suitable for tares, but the most so is a good sandy loam. They are frequently sown on poor lands to be fed off by sheep as a preparation for wheat. They are in general manured for with farm-yard dung, at the rate of ten or twelve cart-loads per acre. The Winter tares should be sown from October to November, and the Spring from March to June, according to the time when they are required. There is no green crop on which the animals of every kind,—milch cows, fatting bullocks, horses, pigs, sheep, &c.,—thrive faster, or are more fond of.

There are other varieties of the Vetch, as the Ratte-ripe, the Wood, the Tufted, the Bush, and the Chinese vetch. None of these are cultivated to advantage except the Bush vetch (*Vicia sepium*) which excels the Lucern in productiveness. It has been cut four times between the 16th of March and the 30th of September; but it is very difficult to preserve the seed, as the pods ripen irregularly, and, as they become mature, burst, and scatter the seeds. It is, however, a perennial plant, and might probably be propagated by dividing and transplanting the root.

Oats or rye are generally sown with tares. The Winter vetch may be sown on poor ground as early as the middle of August, but not later than the end of October, as it would not be strong enough to bear a severe winter. It is a singular fact, that when vetches were first introduced into England from Flanders, they were cultivated, not as a green crop, but for the sake of the seeds, which were given to horses.

SECTION X.

THE CULTIVATED FORAGE PLANTS.

In the infancy of society, when population is thin and scattered, and land is plentiful, the special cultivation of gramineous and other plants for the sustentation of domestic animals is unnecessary. The number of these kept is in proportion to the wants of the inhabitants, and the grazing lands of natural pasture are sufficient for the purpose. If we look at our colonies—Australia, for instance—we find an illustration of the truth of this statement. Millions of sheep and cattle are there fed upon the boundless natural pastures, and there is ample room for countless millions more. It will probably be centuries before the necessity arises for the special cultivation of forage plants, except it be in the vicinity of large towns, for the support of animals kept for the business purposes of the traders, or the luxury of the more wealthy inhabitants.

It is little more than two centuries since England itself was in a somewhat similar position. At that period the entire population of England and Wales did not amount to five millions, and the number of domestic animals kept was in proportion to the wants of the inhabitants. The land was occupied to a great extent in permanent pastures, consisting of parks, meadows, and extensive commons, the proportion of arable land being by far the smallest; and these were uninclosed, and most of them what were called "Lammas lands," which, as soon as the crops of corn were cleared off, were subject to the flocks of the farmers of the district or parish, until the time when it was necessary to prepare the land for sowing again, which was considered to be the latter end of March.* It is plain, that, even if necessary, no forage crops could be grown upon such lands; but, on the other hand, the commons and natural pastures and meadows were amply sufficient—at least, with the exception of the winter months—for the support of the cattle; whilst the hay saved during the summer served for the winter, the turnip not having been cultivated as a field crop.

If we consult Sir Anthony Fitzherbert and others of the early writers on husbandry, we find that they mention the cultivation of red clover "as practised in the Low

* Fallows were open to flocks all the year till Michaelmas, when they were sown with wheat. Fields kept for spring corn were thus common until the 1st of April. The consequence of such a custom was, that every farmer was obliged to till and sow his land exactly the same as his neighbours. It was considered that the sheep, by devouring the scutch grass and other weeds, kept the land clean.

Countries and Italy," but not in England; and even so late as 1645, Sir Richard Weston states that, in the preceding year, he saw a crop of it cut three times in the course of the summer near Antwerp. Soon after this the seeds of the "Great Clover of Flanders" were advertised for sale "at the shop of James Long at the Barge on Billingsgate;" and Walter Blyth first gave directions in his excellent work on husbandry how to cultivate the plant. There is very little doubt that the merit of its introduction, as well as that of the turnip, into field cultivation was due to Sir Richard Weston. From that period the progress of agriculture was rapid. The introduction of *Sainfoin* (*Onobrychis sativa*), Lucern (*Medicago sativa*), Non-such, or Yellow Clover (*Medicago Lupulina*), Ray grass (*Lolium perenne*), followed successively, this latter about the year 1670, and was considered good on cold wet lands, but was thought to exhaust the soil much more than any of the clover species.

It would occupy too much of our space to follow the introduction of all the forage plants, which are now so numerous. From America, as well as from continental Europe, valuable plants have been obtained, and the search after them was further stimulated by the premiums awarded, in the middle of the last century, by the "London Society for the Encouragement of Arts, Manufactures, and Commerce," for the collection by hand of the seeds of the most valuable grasses, as the Meadow Fox-tail, the Crested Dog's-tail, the Meadow Fescue, &c. It is evident that these could not be sown to advantage on the "town lands," subject as they were to be run over by all the sheep and cattle of the district. It was only in the enclosed fields that they could be cultivated profitably; and it is probable that the beneficial results of their introduction were, to a certain extent, the cause of the enclosure of the common or town lands, which by the end of the eighteenth century, and during the first twenty years of the nineteenth, has made such rapid progress. This, and *this alone*, has made the universal cultivation of forage crops of every description possible, by which the amount of food, both for man and beast, has been multiplied ten times, and those enormous fluctuations in the price of provisions which history records, are prevented by the regularity of the supply.

The cultivated forage plants are divided into two distinct classes, the natural grasses and the artificial grasses. These we shall describe separately as we find them in Messrs. Lawson and Son's catalogue and summary. The following is their list of the natural grasses employed in agriculture:—

1. *Agrostis alba*	Fiorin, or Marsh, bent grass.
2. *Agrostis vulgaris*	Common, or Creeping-rooted, bent, Purple bent, Black Scutch, Twitch, or Quick grass.
3. *Aira caespitosa*	Tufted Hair grass.
4. *Alopecurus agrestis*	Slender, or Field, Fox-tail grass.
5. *Alopecurus pratensis*	Meadow Fox-tail grass.
6. *Ammophila arundinacea*	Sea-reed or Mat grass.
7. *Anthoxanthum odoratum*	Sweet-scented vernal grass.
8. *Arrhenatherum avenaceum*	Fibrous-rooted tall Oat grass, French Rye grass.
9. *Brachypodium sylvaticum*	Wood-fescue, or Wood-wheat grass.
10. *Cynosurus cristatus*	Crested Dog's-tail, or Gold grass.
11. *Dactylis glomerata*	Common rough Cock's-foot, or Orchard grass.
12. *Dactylis caespitosa*	Tussac grass of the Falklands.
13. *Elymus arenarius*	Sand, or upright Sea-lyme grass.
14. *Elymus geniculatus*	Pendulous Sea-lyme grass.
15. *Festuca duriuscula*	Hard Fescue grass.

16. *Festuca elatior*	Tall Meadow Fescue.
17. *Festuca gigantea*	Giant Wood Fescue, or Brome grass.
18. *Festuca heterophylla*	Various leaved Hard Fescue.
19. *Festuca loliacea*	Darnel, or spiked Rye-grass-like Fescue, slender Fescue grass.
20. *Festuca ovina*	Sheep's Fescue.
21. *Festuca pratensis*	Meadow Fescue grass.
22. *Festuca rubra*	Red, or creeping, Fescue.
23. *Holcus lanatus*	Woolly Soft grass, meadow Soft grass, or Yorkshire Fog.
24. *Holcus mollis*	Creeping Soft grass, or bearded Soft grass.
25 *Lolium Italicum*	Italian Rye grass
26. *Lolium perenne*	Common Rye grass.
27. *Milium effusum*	Wood, or spreading Millet grass.
28. *Phalaris arundinacea*	Reed-like Canary grass.
29. *Phleum pratense*	Timothy, or Cat's-tail grass.
30. *Poa alpina*	Alpine Meadow grass.
31. *Poa annua*	Annual Meadow grass.
32. *Poa aquatica*	Water Meadow grass, or reedy Water grass.
33. *Poa fluitans*	Floating Sweet Meadow, or Water grass.
34. *Poa nemoralis*	Wood Meadow grass.
35. *Poa pratensis*	Smooth-stalked Meadow grass.
36. *Poa trivialis*	Rough-stalked, or Stoloniferous Meadow grass.
37. *Trisetum flavescens*	Yellowish Oat grass.

We shall now give a short description of the above and their uses, also abridged from the same work of Messrs. Lawson and Son.

1. *Agrostis alba.*—Root perennial, fibrous in marshy soils, but becomes a creeping plant on a light and dry soil. Height, 1½ foot; flowers in July. There are several varieties of this grass, and the *Fiorin* of Dr. Richardson is considered to be the *A. alba, var. Latifolia.* It should never be sown on a damp or irrigated peaty soil. The *Agrostis stolonifera* is a variety of the *A. alba.*

2. *Agrostis vulgaris.*—This is the common Twitch grass, better known by the farmer than esteemed, and more difficult to be got rid of than to be obtained. In a light soil it will run for yards in a season; and being full of joints in the root, and every joint capable of reproduction, it thrives marvellously if neglected. Sheep are the only animals that feed upon it, and if they are turned into a ploughed field where it prevails, they will pick out the roots and devour them; otherwise nothing but fire will destroy them.* No sane farmer would ever attempt to cultivate it.

3. *Aira caespitosa.*—This is a perennial grass having long flat leaves, fibrous roots, and is about 4 feet high in the stem. This plant delights in a damp and marshy soil, and grows in tussocks. It is a coarse, wiry plant, and not much eaten by the cattle when they can find more palatable food. It is therefore desirable to exterminate it as soon as possible wherever it is found in a pasture or meadow, as taking the place of better kinds of food. Its only use is to furnish a cover for game, by which it becomes a double nuisance to the farmer.

4. *Alopecurus agrostis.*—This is a biennial, fibrous-rooted grass, only useful to sow

* The writer had once a field which, having been neglected by a former occupier, had become full of Twitch grass. The field was intended for turnips, but, the weather proving wet, it was found impossible to gather the roots from the soil. He therefore collected the Twitch in heaps with the soil adhering, and burned the whole together. The ashes, of which there were forty or fifty loads, were then spread over the field, and the turnips sown, and they proved the best crop that was ever grown on the farm.

amongst others on high sandy soils on the sea coast, where it is found superior to the common rye-grasses.

5. *Alopecurus pratensis.*—A perennial, fibrous-rooted plant; it flowers in May and June. It is one of the earliest and best pasture grasses, and forms the greater portion of many of the richest natural pastures of Britain. It yields, however, but little hay, as it produces few stalks, but the root-leaves are very broad, long, soft, and slender, and it grows rapidly after being cut down, or fed off by cattle or sheep. It springs naturally on the best mixed soils, but requires two or three years to bring it to its full productiveness.

6. *Ammophila arundinacea.*—Root creeping, perennial; height from $1\frac{1}{2}$ to 2 feet, and flowers in July. It is the celebrated *Marram,* which being planted on the sand-banks of the coast of Norfolk and other parts, forms in due time an effectual barrier to the inroads of the waves. When once it has taken hold of the sand, by its fibrous and wiry roots, nothing can destroy it; and the sand covering it at every fresh tide only adds to its strength. It is called *Mat grass,* because the foliage is used in making mats, for which it is peculiarly suited. It is of no use as fodder.

7. *Anthoxanthum odoratum.*—A perennial, fibrous-rooted plant, height about $1\frac{1}{2}$ foot; flowers in May. It is not a favourite grass with cattle or sheep, nor is it a good yielding grass, its chief excellency being its early growth, and its continuing to throw up foliage throughout the autumn and early winter. When, therefore, mixed with other grasses, it helps to prolong the grazing season. It is suited for parks and pleasure-grounds, but is of too coarse a quality for the lawn or grass-plot.

8. *Arrhenatherum avenaceum.*—Another fibrous-rooted perennial, flowering in July, and yielding an abundance of herbage, the bitter taste of which is much against its usefulness. It is a singularity of this grass, that on light dry soils it forms a bulbous root, whilst on moist rich land the root is fibrous. Lawson, however, denies that this is the case, except it may arise from a very long continued growth on their respective soils; and he seems to doubt whether even this will produce such an effect. This Oat grass is cultivated in France to a greater extent than any other kind, and is called there the *Ray grass de France.* It grows rapidly after being fed down, and is useful for sowing in plantations, but is not suited to ordinary pastures, on account of the repugnance of the horses and cattle to its bitter taste.

9. *Brachypodium sylvaticum.*—Perennial and fibrous-rooted; stem 2 feet high; flowers in July. This grass is suited to parks and plantations only, being chiefly eaten by deer, hares, and rabbits; it should, therefore, be sown in such places plentifully, to keep the vermin at home if possible.

10. *Cynosurus cristatus.*—Root fibrous, perennial, leaves short, rather narrow, and tapering to a point; height about 1 foot to 2 feet; flowers in June and July. It will flourish on either dry or moist soils, and its foliage is eaten with eagerness by both cattle and sheep, but they leave the stalks, which stand and ripen for seed. It is said that sheep are less liable to the foot-rot, when fed on pastures where this grass prevails, than on such as are made up of more tender and soft-leaved kinds. It forms a close turf, and is sometimes too predominant in pasture lands, but is well adapted to lawns and bowling-greens, where it is kept under with the scythe. It thrives well in water-meadows.

11. *Dactylis glomerata.*—Root fibrous, perennial; flowers in June and July. This

grass, the rough Cock's-foot, is well known for its abundant foliage, the stem being from 1 foot to 2 feet in height. It grows in tussocks, sometimes very large, and yields an abundance of coarse but palatable herbage, of which both sheep and cattle, but especially the former, are very fond. Its high tufts are very unsightly in a pasture ground, and many farmers have them cut out when they appear, especially in those near the house. On a light soil its roots penetrate deep, and take a firm hold of the ground; but on a close clay it is very soon trodden out by horses and oxen. It is much cultivated in America, from whence it is supposed to have been brought into England. Messrs. Lawson have made a series of experiments with this grass, the results of which induce them to recommend its cultivation in alternate husbandry, where the land is intended to be kept in grass for two or more years before being again broken up. It will not last as pasture, under any circumstances, more than five or six years.

12. *Dactylis caespitosa.*—Fibrous-rooted, perennial. Stems numerous, and rising 3 feet or 4 feet, smooth, compressed, leafy, and pale yellow, abounding in saccharine matter. Flowers in February and March. The densely matted roots form isolated tussocks or hillocks 3 feet to 6 feet in height, and 3 feet or 4 feet in diameter, from which the foliage and stems spring; these are much more succulent than those of the *D. glomerata.* It is adapted to lands bordering on the sea coast, where other grasses will not exist; yet attempts to cultivate it on our coasts have not succeeded. Its highly saccharine properties render it very acceptable to cattle, which, if they are allowed to feed upon it, will eat down the crown to the very ròot, and soon destroy the plant. It has been successfully cultivated in the Orkneys and Lewis, which are the only places where it has hitherto been acclimated in the United Kingdom. The stems and leaves are very succulent and sweet, and it is pronounced by Professor Johnston to be exceedingly nutritive.

13. *Elymus arenarius.*—A perennial with powerfully creeping roots; height, 2 feet to 5 feet; flowers in July. The leaves are hard and armed with spines, and scarcely any animals will feed on it, either green or as hay, if they can get other food, on account of its coarseness. Yet Sir Humphry Davy found by analysing the soluble matter, that it contained one-third of its weight of sugar. This alone would indicate highly nutritive properties, and the hay from it, when cut into chaff, mixed with other food, has been recommended as affording excellent fodder. It is chiefly sown, like the *Ammophila arundinacea,* on loose sands, to repel the encroachments of the sea, for which its strong, creeping, matted roots eminently fit it. It is used extensively in Holland for this purpose. The usual way of cultivating it is, by planting turf at regular and short intervals over the surface, and then to sow the seeds of either or both these plants in the interstices by mixing them with clay attached to small pieces of straw rope, and dibbling these into the sand.

14. *Elymus geniculatus.*—Spikes long and slender, often jointed or bent down; perennial, and, like the preceding, grows naturally on the sandy sea shore, but not common in Britain. The foliage is narrower than that of the *E. arenarius,* and it is a more open and less spreading plant. Its seeds supply food for wild fowl, and it grows in tufts 4 feet or 5 feet in height on almost any soil. On warrens and sandy tracts it affords good shelter for game.

15. *Festuca duriuscula.*—Root rather creeping; perennial; throws off lateral shoots; height, $1\frac{1}{2}$ to 2 feet; stem-leaves broader and more flattened than the root-leaves. It

is one of the best native grasses for general purposes, and constitutes the greater part of the herbage of the natural permanent pastures of this country. It is well adapted for sowing in parks and pleasure-grounds on account of its verdant appearance throughout the winter. It will thrive on most soils, and yields a great quantity of food, bearing alike the drought of summer and the severe frosts of winter. There are two other varieties of this grass, the *F. purpurata* and the *F. serrata*. To all of them sheep are found to display a great partiality, both in the green state and as hay.

16. *Festuca elatior.*—A perennial, fibrous-rooted plant, creeping, and growing in large tufts; stem from 3 feet to 5 feet high; flowers in July. It is nearly double, in all its parts, the size of the *F. pratensis,* and grows naturally in good moist soils, on the banks of rivers, in shady places, and on rocks near the coast. It yields an abundant crop, and, although a coarse grass, is generally liked by cattle. There are many varieties of it, as the *F. elatior fertile,* the *F. elatior sterile,* and the *F. elatior giganteam.* This latter is distinguished by its gigantic growth, reaching from 5 feet to 6 feet, and by its large seeds.

17. *Festuca gigantea.*—Root fibrous and creeping; perennial, with long, broad, ribbed, and bright green leaves; 4 feet to 5 feet in height; flowers in July and August. It yields an abundance of herbage, but is preferred by cattle as hay rather than in the green state. It contains but little nutriment, and can only be cultivated to advantage where the land is shaded by trees, and better grasses will not grow. In plantations it forms a good cover for game.

18. *Festuca heterophylla.*—Perennial, fibrous-rooted; culms numerous and upright, about 4 feet or 5 feet high; flowers in June and July. It is a native of France, and is found in different parts of the Continent, especially in the Low Countries, from whence the seeds are brought. It suits this climate, and produces *one* abundant crop of hay, but yields very little after-grass. It answers to mix with other seeds on upland pastures, whether intended for hay or grazing.

19. *Festuca loliacea.*—Fibrous-rooted and perennial; flowers in July. It is adapted for marshy situations and rich meadows, occasionally overflowed; and it forms a considerable portion of the herbage of the fen districts both in England and Ireland, but is rarely found in Scotland. It produces little seed, and is considered a hybrid between the *F. pratensis* and the *Poa fluitans.*

20. *Festuca ovina.*—Fibrous-rooted and perennial; leaves narrow and rough; grows in small tufts; stems square, and 12 inches to 18 inches in height; flowers in June and July. Grows naturally on light, dry, and sandy soils, and on mountain sides. It is well adapted to sheep-walks, and constitutes the greater part of the herbage of the Highlands. It yields but little feed, but being so well relished by sheep it should always form a portion of the mixed grasses in their pastures.

21. *Festuca pratensis.*—Root fibrous; perennial; leaves broad, and of a bright green colour; height of stem from 2 feet to 3 feet; flowers in June and July. An excellent grass, especially for permanent pastures, possessing the best, but not the objectionable, properties of rye grass. It grows naturally on superior soils, if moist, and forms a considerable portion of natural pasture. It makes excellent hay, and the leaves of the herbage are succulent and tender, and much liked by cattle. It is not adapted to alternate culture, except mixed with other grasses.

22. *Festuca rubra.*—This is considered a variety of *F. duriuscula,* but is not of equal

value, except for sowing on shifting sands, where its fibrous and creeping roots assist to consolidate the soil. It is useful also on the slopes of railway cuttings and embankments.

23. *Holcus lanatus.*—Leaves downy; root fibrous; perennial; height, 1 foot to 2 feet; flowers in June and July. It grows naturally on light, damp soils, is very productive and easily cultivated, but is of little value either for hay or pasture. Its nutritive matter consists of mucilage and sugar, but it contains very little sub-acid or saline taste, which renders it unacceptable to cattle either green or as hay. Where this grass prevails, salt should be sprinkled over the layers of hay when stacked, which will render it more palatable and healthy, but it is by no means a desirable plant where other grasses can be grown. The panicles are soft and woolly in appearance, and exhibit a variety of shades of colour, from a white to a beautiful red, but a whitish ground is most common.

24. *Holcus mollis.*—A perennial, creeping root, sometimes extending 4 or 5 feet in height; leaves pale green and rough; flowers in July. The culms are fewer, and the panicles looser in this than in the *H. lanatus*; and it has longer arms, broader leaves, and powerfully creeping roots. It grows chiefly in dry woods, bushy places, and waste ground, and it is only in such places that it is of any use, and it should be rooted out wherever any other kind will grow.

25. *Lolium Italicum.*—A biennial or triennial fibrous-rooted plant from the south of Europe. It flowers in May and June. It has only been cultivated in England about thirty years, but has now become thoroughly acclimatised, and is a generally favourite grass. It is considered by botanists as a variety of the *Lolium perenne,* from which it scarcely differs in any essential particular as to its form. Various opinions prevail as to the real merits of the Italian rye-grass, but its continually increasing cultivation is the best proof of its excellence and superiority over the common rye-grass. It has a stronger braird, is much earlier in the spring, and arrives sooner at maturity. Its foliage is broader and more abundant, and of a fresher green, but it is said to tiller less, and grows taller and more upright. It produces but little seed, which, however, is of no consequence, as most of the seedsmen find it better to import the seed than to grow it, as it can seldom be saved either pure or good. It is much preferred by cattle to the common sort. It soon shoots again after being mown, and will bear cutting three times on a favourable soil and a good season. It is valuable both for pasturage and for hay, but it cannot be depended on with certainty for more than two seasons, although instances have been known of its lasting five or six years, and yielding annually an average of $7\frac{1}{2}$ tons of dry hay per acre; but this has been ascribed rather to the ground being seeded in the making of the hay, than to the preservation of the old plants. It is the tendency of all the varieties of the rye-grass easily to shed their seeds in harvesting the hay, if it be at all matured. There is no doubt that when fed off, the plants may be preserved more than two years, it being a property of all the gramineous plants to throw out fresh tillers if the flowering stem is eaten or cut off, as they will continue their endeavours to arrive at maturity. It has sometimes been sown as a substitute for tares, with good effect.

26. *Lolium perenne.*—Fibrous-rooted, biennial, triennial, or quadrennial; flowers in June and July. It grows naturally in meadows, and rich pastures. It suits a variety of soils, is easily propagated, and ripens uniformly; but there are many other grasses that

yield more fodder, though none that are preferred to it by the cattle and sheep. There are many varieties,—as, the *Evergreen* or *Devon Evers*, the *Fine-leaved* (*L. perenne tenere*), *Mollis*, *Orkney* or *Pollexfen's*, *Parey's* (*L. perenne ramosum*), *Roughead's*, *Russel's*, *Spreading-stickneys*, and *Whitworths*. This last is an excellent grass, of early and late growth, very tenacious of life, has remarkably fine foliage, and makes an excellent mixture for sowing in pleasure-grounds and parks.

27. *Milium effusum*.—Fibrous-rooted and perennial; flowers in June; stem from 4 to 6 feet high. It yields a large after-math when the first crop is taken off, and is relished by cattle. It grows naturally in cool, shady places, and in rich vegetable soils on the banks of rivers, &c.

28. *Phalaris arundinacea*.—A creeping perennial root; height, 4 to 6 feet; flowers in July. It is a coarse grass and not liked by cattle, who will not eat it freely unless cut into chaff and mixed with other food. It yields a large bulk of hay, and is sometimes used for litter.

28. *Phleum pratense*.—This plant comes from America, where it is extensively cultivated. It has a creeping perennial root, stems 1½ to 2 feet high, and flowers at the end of June. It is a good deal cultivated now in Britain, thriving best on moist soils and newly reclaimed moor lands. It affords more nutriment when its seeds are ripe than when cut in flower, so that its seeds may be saved without lessening its value as a hay crop. It is best suited to a tenacious, strong, moist soil, and ought to form a mixture with other sorts either in alternate or permanent pasture. This is not an early grass, but is about equal in that respect to the common rye-grass.

30. *Poa alpina*.—Perennial; fibrous-rooted; grows in tufts; height from 4 to 12 inches; flowers in June. It is suited to any situation, but grows naturally on mountainous pastures, where it is a valuable grass, because but few other species will succeed there. It generally propagates itself by tillers, producing but little seed, so that it was difficult to introduce it into remote districts; but a new and fertile-seeded variety has been discovered, which has by cultivation furnished a supply of seed for general use.

31. *Poa annua*.—Roots fibrous, annual, height about 9 inches; flowers at most seasons of the year; it grows any and every where, and is troublesome in the corn-field. Sheep are very fond of it, and as it seeds the ground naturally, it helps to fill up a pasture. It is sown on grass lands where the perennial grasses have been destroyed by frost. It grows rapidly, and ripens its seeds in four or five weeks after sowing.

32. *Poa aquatica*.—This, although a coarse grass, is considered by Mr. Lawson the most productive in herbage of all the British grasses. It is a powerfully creeping root, growing naturally by the sides of muddy ponds, fresh-water lakes, and rivers, and on any rich soil subject to the action of water. It flourishes in the fens of Lincolnshire and Cambridgeshire, where it forms an excellent resource for the lean stock during the winter months.

33. *Poa fluitans*.—This grass, like the former, loves the neighbourhood of water, and grows naturally in moist or marshy places. It is fibrous-rooted, with stems from 2 to 3 feet high. It thrives *in*, as well as by, water, and is eaten eagerly by all kinds of animals. It is well adapted to water-meadows, and yields a large produce. The seeds are a luxury to wild fowl, and to trout and other fish, and they form the *manna-kroop* or semolina of commerce, used in soups. They are gathered, on parts of the Continent, by placing a cloth under the panicles and beating them off with a stick, repeating the

operation every two or three days, till all the seeds are gathered. The plant will yield a considerable produce even on moderately dry soils.

34. *Poa nemoralis*.—This grass grows naturally in shady woods, but will also thrive in open places, and on poor soils. The root is fibrous, its height $1\frac{1}{2}$ foot to 3 feet, and it flowers in June and July. It is well adapted to pleasure-grounds, forming a fine and close sward under trees. It is an early grass, and throws out abundance of feed in the spring, but yields little after-math. If allowed to shed its seed it will fill up the place of annual and biennial grasses and weeds that die out. The Hudson's Bay Meadow grass (*P. nemoralis sempervirens*), is considered a valuable variety for parks and lawns, on account of its perpetual greenness, thick growth, fine foliage, and constant reproduction.

35. *Poa pratensis*.—A creeping root; smooth stem, about 3 feet high; flowers in May and June. Grows naturally in dry situations and rocky soils. It yields a large amount of herbage at an early period of the season; but it impoverishes the soil by its creeping roots, and after June, produces very little food. For hay, it should be cut while in flower, to prevent the seeds from ripening, which would reduce the bulk and value of the produce.

36. *Poa trivialis*.—A perennial, fibrous-rooted plant; flowers in June and July; height, 2 to $2\frac{1}{2}$ feet. It is a water-grass, and throws out shoots from the base of the culm, which trail along the ground, and strike roots from every joint, by which they reproduce an abundance of fresh plants. In damp meadows and pasture grounds this stoloniferous property makes it a valuable plant, as the shoots begin to grow early in the spring, and form a close sward. In the drought of summer they dry up, but shoot again towards autumn, and continue green throughout the winter, unless very severe. It will not answer for lawns or pleasure-grounds, being apt to rake or sweep up, leaving the work rough and unfinished.

37. *Trisetum flavescens*.—Perennial, and fibrous-rooted; height, $1\frac{1}{2}$ foot to 2 feet; flowers in July. Sheep are fond of this grass, and it yields a great bulk of fine herbage on light dry soils, when mixed with other grasses, either for hay or pasturage. It should never be sown alone; and if allowed to ripen its seeds, it will die out, although considered perennial.

We may remark that annual or biennial grasses may be preserved longer by cutting or feeding them down, *before* they are matured. The original plant will then die, but the roots will throw out shoots or tillers, and thus renew its existence. The cause of this is, that the plants require to fulfil their mission, namely, the production of perfect seeds; and if frustrated in this, by cutting down, they immediately throw out fresh plants from the old root, which then dies, with the abortive stump of the culm. This principle will apply as well to the cereal as to other grasses. If the culms of any of these be cut or broken off when advancing to the earing, the root will throw out fresh tillers, and then die with the first culms.

SECTION XI.

THE ARTIFICIAL GRASSES.*

The following is Messrs. Lawson's list of clovers and other plants that come under the above denomination :—

1. *Achillea millefolium*	Yarrow, or Common Milfoil.
2. *Cichorum intybus*	Wild Chicory, or Succory.
3. *Cytisus scoparius*	Common Broom.
4. *Lotus corniculatus*	Common Bird's-foot Trefoil.
5. *Lotus major*	Greater Bird's-foot Trefoil.
6. *Medicago lupulina*	Common Yellow Clover, or Trefoil, Nonsuch, Black Medick, Lupuline.
7. *Medicago sativa*	Lucerne.
8. *Onobrychis sativa*	Common Sainfoin.
9. *Petroselinum sativum*	Common Parsley.
10. *Plantago lanceolata*	Common Plantain, or Rib-grass.
11. *Poterium sanguisorba*	Common Burnet.
12. *Primula veris*	Common Cowslip, or Paigle.
13. *Trifolium hybridum*	Hybrid, or Alsike Clover.
14. *Trifolium incarnatum*	Scarlet, Crimson, or Italian Clover.
15. *Trifolium minus vel filiforme*	Yellow Suckling, or Trefoil.
16. *Trifolium pratense*	Common, or Red Clover.
17. *Trifolium pratense perenne*	Cow-grass, or perennial Red Clover.
18. *Trifolium repens*	White, or Dutch Clover.
19. *Ulex Europæus*	Common Whin, Furze, or Gorse.
20. *Vicia sativa*	Common Tare, or Vetch.

1. *Achillea millefolium.*—A fibrous-rooted perennial; flowers in June and July, the flower being white, pink, or even deep red. It grows naturally in dry pastures on light soils. When mixed with common grasses it affords grateful feed for sheep. It is highly astringent, and is useful rather as a condiment than for the amount of nutritive matter it yields. It is, therefore, mixed with other seeds for sowing on sheep-pasture, and may be sown on the poorest and driest soils to advantage, as it withstands the severest drought.

2. *Cichorum intybus.*—A deep-rooted perennial, flowers in July. Flowers blue, in pairs, with very short footstalks, but placed on long branching stems; leaves of various shapes and colours, hairy and runcinate; roots thick and fleshy; height, when in flower, from 4 to 8 feet or more. It grows naturally on the borders of fields, and yields a great bulk of root and stem foliage, which is eagerly eaten by cattle; but it is said to give an unpleasant taste to milk. It thrives best on rich, light soils, well drained; and may be sown either in drills or broadcast, or mixed in small quantities with other forage seeds. If the first cutting takes place about the time of flowering, three or four crops may be obtained in a favourable season. The *Chicorée à Café*, or Coffee Chicory, is a well-known variety of this plant.

* Morton, in his "Cyclopædia of Agriculture," justly remarks that the term "grass," is misapplied to such productions as Clover, Sainfoin, Lucerne, and plants of that description, having none of the distinguishing characteristics of the graminaceous family; and that the only plants that can be mistaken for grass are rushes and sedges, and that these possess decisive marks to distinguish them from grasses. In using the word, therefore, we only follow the common and accepted plan adopted by all seedsmen and others who have written on the subject.

3. *Cytisus scoparius.*—This plant has been recommended for sheep pasture to supply them with green food in winter. It is, however, highly diuretic; and Messrs. Lawson justly question whether the sheep do not take it medicinally rather than for its nutritive properties, and consider it doubtful whether it can be introduced with advantage or propriety as a forage plant.

4. *Lotus corniculatus.*—A prostrate, deep-rooted perennial. Flowers about the end of June, and until the end of August; flowers a bright yellow colour; stems decumbent and smooth; height from 6 inches to 1 foot. It loves light, dry, and very elevated inferior soils, on which it will yield a greater bulk of herbage than any of the cultivated clovers. It is equally nutritious with any of the Trefoils, and is eaten eagerly by the sheep and cattle. From the depth of its rooting it withstands drought without injury, and retains its verdure after other grasses are burnt up.

5. *Lotus major.*—A spreading, creeping perennial; flowers in July and August; grows naturally in moist situations, and loves a peaty soil. It yields a much greater bulk of herbage than the last named, and is also distinguished from it by the different form of the root and the size of the seeds, which are only one half those of the *L. corniculatus*, and of an olive green colour, whilst the latter are of a dark brown.

6. *Medicago lupulina.*—A fibrous-rooted biennial or sub-perennial; flowers from May to August: is generally sown mixed with other clover, or with rye-grass, and loves dry pastures and cultivated grounds. It yields a great abundance of seed. It is not a profitable plant, nor are sheep or cattle partial to it alone, and only eat it from necessity when mixed with a greater quantity of more acceptable food. It should, therefore, be mixed sparingly.

7. *Medicago sativa.*—This is an invaluable plant, having an erect stem, branching and smooth. The flowers are in clusters, of a purplish colour; the root is perennial, thick, and branching, and penetrates from 6 to 12 feet into the ground; height of stem about 3 feet. It loves a deep, loose, and even sandy soil, also a calcareous sub-soil, with a medium black loam above. On such soils no drought will affect it; and it will be ready for the scythe a fortnight or three weeks sooner than the common rye-grass and red clover. Although it may be cut the second year after sowing, it is only in the third year that it attains its full perfection, after which, for eight or ten years, it will continue to yield at least four good crops a year, if manure is applied to it in sufficient quantities. It requires to be kept clean from weeds. Lucerne has for many centuries been cultivated in the south of Europe; but was not introduced into Britain till about the middle of the seventeenth century, nor is it at present used to the extent its valuable properties entitle it to. This is probably owing to its permanent character interfering with the regular course of husbandry.

8. *Onobrychis sativa.*—Root fusiform, woody, and penetrating deep into the ground. It is a perennial, leguminous plant, bearing spikes of flowers of a beautiful pink or flesh-colour on long footstalks. Stems upright and two to three feet in height; flowers from June to August. It loves a light, chalky soil, and is extensively cultivated on the thin, chalky downs of the south of England. It is sometimes sown with a corn-crop as other clovers and grasses, which shades and keeps it moist during the first summer. In this case only half the usual quantity of corn is sown that a full crop requires. The sainfoin is drilled at right angles with the corn-crop. It usually stands in full produce for eight or ten years on a chalk sub-soil, and seven or eight on a sand or gravel. This

term may be increased by top-dressing. Like lucerne, when at maturity, no drought will affect it.

9. *Petroselinum sativum.*—A fusiform-rooted biennial or triennial, flowers in July; height 1 to 3 feet. It was first introduced into England from Sardinia in 1548; and it is supposed to preserve sheep from the red water and liver rot, and is recommended for sowing in pastures where they are kept. All herbivorous animals are fond of it; and it may be used in small quantities to advantage. About 1 lb. of seed to the acre is enough on a light soil; and it will provide for its own preservation by shedding its seed, if the pasture is not fed too bare.

10. *Plantago lanceolata.*—A fibrous-rooted perennial; flowers in May and June. Grows naturally in pastures and in waste places. All cattle and sheep are fond of it, but it occupies too much space by its spreading leaves to be a profitable plant, and it loses its quality as the season advances.

11. *Poterium sanguisorba.*—A fibrous-rooted sub-perennial; height 2 feet or 3 feet; grows naturally on the chalky pastures, and flowers in June and July. It was extensively cultivated formerly on such soils, but other and better plants have now superseded it, though some of the old farmers on the south downs still adhere to it.

12. *Primula veris.*—Of no agricultural value.

13. *Trifolium hybridum.*—The Alsike clover is a Swedish plant, and is one of the best perennial clovers, more cultivated in Scotland than in England. It is fibrous-rooted; flowers in June and July; has a branching stem and globular head or flower. It is found to thrive on soils termed clover-sick, which is a strong recommendation.

14. *Trifolium incarnatum.*—This is an Italian annual that flowers in June and July; the head or flower being a bright scarlet colour. The stem is upright and branched, and the whole plant is hairy. It yields an abundant and excellent crop of fodder, and has succeeded well in the south of England. When sown in autumn it may be cut and cleared from the ground the beginning of the following June, and the land ploughed up and prepared for autumnal sowing. It yields an abundant crop of hay, which horses prefer to any other. A late variety (*T. incarnatum tardif*) has been introduced, which flowers when the common one is over, and produces one-third more hay.

15. *Trifolium minus vel filiforme.*—A fibrous-rooted perennial; flowers from May to July; head small, and colour of flower a bright yellow. It succeeds in dry gravelly, or rocky places, where no other more valuable plants would live, but it is not itself valuable enough to be sown alone on soils where better grasses would thrive. It affords a good mixture for lawns where the soil is too dry for white clover.

16. *Trifolium pratense.*—A fusiform-rooted sub-perennial; flowers in June and July; colour a reddish purple. The English red clover has large purple seeds, and grows luxuriantly on superior soils, for which it is adapted. There are many varieties of this clover, as the Holstein, German, Cologne, Dutch, Flemish, French, American, and Normandy Red Clover. The most valuable are the Dutch and French varieties. The former succeeds on strong soils; the latter is more suited to soils in sheltered situations.

17. *Trifolium pratense perenne.*—Compared with the Common Red clover, the flowers, foliage, and stems are darker coloured, the leaflets narrower, and the whole plants much more hairy, and the roots are more fibrous. It grows in old pastures, heathy moors, and by the way-side, presenting many varieties of colour and habits of growth, but all agreeing

in permanency of duration. It has been much sought after of late years, being found useful on account of its permanent character. The varieties of this plant are numerous, but the most valuable are the following:—

1st. *Duke of Norfolk's Cow Grass*, the stalks, leaves, and flowers of which are darker, the roots more fibrous, and the plant earlier by a week than the Common Red clover.

2nd. *Perennial Red Clover* of Argovie. Originally from Switzerland, where it is much cultivated. It is reckoned by the French farmers the most permanent variety they have, and they cultivate it extensively.

3rd. *Perennial Red Clover of Germany* resembles the last, but is a few days later, and grows more luxuriantly.

18. *Trifolium repens.*—A fibrous-rooted perennial; flowers throughout the summer months and into autumn; the flowers white; the leaflets heart-shaped inversely, and having a dark blotch near the base; stem creeping on the ground, and rooting at the knots. Grows naturally in pastures and almost everywhere else; and in lawns is sometimes too prevalent, as it eradicates the finer grasses. On pasture lands it is indispensable, but is apt to scour the cattle in a wet time if too predominant; and, as on lawns, it usurps the place of finer grasses.

19. *Ulex Europæus.*—The Whin or Furze has been in use for cattle and sheep, time out of mind during the winter months. They are given in the green state, but bruised either by hand or machinery, in order to divest the prickles of their sharp points. In this state all herbivorous animals are fond of the whin; and sheep do not hesitate to feed on it whilst on the root, when the ground is covered with snow, but not else. They, however, thrive and fatten upon it better than on grass. It is a valuable plant in mountainous countries below the level of 900 feet; but no farmer would sow it on valuable land, for if it once gets hold of the soil, it is difficult to be rid of it. It is also calculated for sandy soils, on which the culture of cereals and grasses is precarious. From 20 lbs. to 24 lbs. per acre is the quantity of seed required, with or without a corn crop. They should be mown annually and close as a winter food.

20. *Vicia sativa.*—We have already described this plant amongst the leguminous plants at Section IX., p. 502.

SECTION XII.

THE SORGHO, OR CHINESE SUGAR-CANE.

This plant (*Holcus saccharatus*), has received considerable attention in France, where it is cultivated, in the southern departments, for the purpose of manufacturing sugar. In the north it has also been introduced for forage; and, as attempts have been made to extend the cultivation in this country, it is desirable to put our readers on their guard by stating what has been the experience of French farmers in adopting this plant in their system of feeding cattle.

There is no doubt in the world that the Sorgho contains a large proportion of saccharine matter; ten per cent. being commonly extracted from its juice or sap. Nor is it less certain that the produce of forage is very large, amounting to 40 tons per acre in the five months of its growth. These two circumstances together, have offered a strong inducement to the farmers to adopt it in their general husbandry. On the other hand, charges have been laid against it on account of alleged pernicious qualities it has been said to possess, amounting to a virulent poison, on which account it cannot be safely given to cattle. The following extract from a letter of a French nobleman, the Marquis de Vibrane, gives a clear and intelligent statement of his own and neighbours' experience in using the Sorgho as forage. It is proper to state that the Marquis is himself a member of the Imperial Zoological Society of Acclimatisation, and that in that capacity he received a portion of the seeds of the Sorgho, on which to experiment, and he gives in his letter the result.

"The Sorgho," he says, "is not a violent poison for cattle; but, if the effects observed, not only in my experiments, but also with many of my neighbours, are constantly renewed, we must necessarily attribute to this plant a deleterious influence. On a farm which I occupy myself, twenty-five horned cattle have been fed during one month exclusively on Sorgho, and from the very day of the introduction of that plant in feeding them, the journal of the farm shows a diminution in the produce of milk to the extent of one half. The same average was produced during every month of the cattle feeding on Sorgho.

"On the other hand, a case occurred of one cow fed on Sorgho, which was blown, which caused her death. Any other forage might have caused a similar accident; but what many of my neighbours have asserted is, the sterility of the cows fed on Sorgho! If these two facts—sterility on the one hand, and diminution of milk on the other to the extent of one half—are regularly repeated in consequence of feeding on Sorgho, we must conclude that this plant is pernicious, since it impedes or diminishes all kinds of production, by injuring the secretions, which must necessarily provoke perturbation in the animal organism; all morbid causes having their origin in suppressions of this nature.

"I know no possible amelioration of the soil without abundance of forage, and its regularly successive production in the course of crops, on which account I deeply regret being compelled to abandon the culture of the Sorgho. The desire of preserving for so luxuriant a plant its place in the production of forage plants, and, on the other hand, the fear of introducing into the bosom of our cultivation a dangerous auxiliary, ought to be for us a double and powerful motive, prudently and conscientiously to renew the experiments."*

Another writer in the same journal, however, gives an account of the culture of the Sorgho for forage by a M. Nivière of Peyzieux, who, on a farm of sixteen hectares (about 39½ acres), kept forty-five oxen or cows, two horses, and 100 sheep, after three years' cultivation of land, so situated that he could purchase no manure, and in the first instance had none to begin with. It had been let for twelve years to *Metayers*, too poor and ignorant to cultivate it properly, and too far off to be overlooked by the proprietor. He began by raising a crop of Jerusalem artichokes, with which he fed a few bullocks. With the manure made by them, he prepared some land for Sorgho, and

* *Journal d'Agriculture Pratique*, Jan. 5, 1859.

thus was enabled both to increase the produce of forage, and the means of further increasing it, by keeping more stock. Lime and turf ashes were the only dressing he could otherwise procure; and these, mixed with that produced by the cattle, enabled him to keep the large number stated above. It was to the enormous fertility of the Sorgho that he ascribes the success, the produce per hectare (2 acres, 1 rood, 35 poles), being 120,000 kilometers, or 125 tons, or more than 50½ tons per acre. It ought, however, to be stated that only lean stock were kept, and that these were sold out at the approach of summer, at which season only the working oxen were retained. The proprietor always purchased the cattle in October, they being cheaper at that period than at any other. For two months after the purchase they eat nothing but Sorgho, which is passed through a chaff-cutter before it is given to them.

On these two statements, the writer remarks that the first says nothing about the effect of the Sorgho-feeding upon any other animals than milch and breeding cows; and the second confines his grazing to the preparation of stock for fattening afterwards. There is, therefore, no information as to the value of the Sorgho in fattening; and it requires a series of experiments to learn the extent to which its injurious properties will affect other cattle than cows. We shall, therefore, now recommend the reader to go cautiously to work in experimenting upon this plant, which ought not to be condemned on account of its alleged injurious effects. It is well-known in France that if milch cows are fed on the refuse of the Silesian sugar-beet, *they will soon go dry*, and that calves suckled by cows so fed *will die*. Yet oxen and pigs will fatten well upon it. The large proportion of saccharine matter in the Sorgho ought to give it great fattening power; and, whatever may be the cause of the deleterious effect upon milch cattle, it is still to be proved that it is equally injurious to others. We believe there is no European forage plant equally productive; and should it, after all, prove innoxious to fattening cattle, it will be one of the most valuable acquisitions to the farmer that was ever introduced into the country, whether for consumption in the green state, or as hay, in both which capacities all cattle appear to be fond of it.

SECTION XIII.

ANALYSES OF GRASSES.

An inquiry was instituted by Professor Way, at the request of the Royal Agricultural Society of England, to which he was chemist, to ascertain the comparative value of some of the natural and artificial grasses by analyses.* In this undertaking he was directed to establish—

1. The proportion of water in each grass as taken from the field.

* It may be stated here that in the year 1824, Mr. Sinclair, the gardener to the Duke of Bedford at Woburn, was directed by his Grace to iostitute a series of experiments in order to ascertain by analyses the products and nutritive properties of different grasses and other plants. Ninety-seven kinds of grass were thus examined, and the results were published by him in the "Hortus Graminius Woburnensis," and also in the appendix to Sir Humphry Davy's "Elements of Agricultural Chemistry." The details of these experiments are too long for insertion here.

2. The proportion of albuminous or flesh-forming substances including, without distinction, all nitrogenous principles.

3. The proportion of oily or fatty matters which may be called fat-forming principles.

4. The proportion of elements of respiration or heat-producing principles, amongst which are included starch, gum, sugar, pectic acid, &c., all the non-nitrogenous substances, indeed, except fatty matters and woody fibre.

5. The proportion of woody fibre.

6. The amount of mineral matters, or ash.

The specimens were picked out, plant by plant, each specimen by itself, from the fields in which they were growing naturally, or mixed in the ordinary mode of cultivation, and were not raised expressly for analysis. The results of the investigations were as follows :—

No. 1.—Analyses of Natural Grasses as taken from the Field.*

Names of Grasses.	Water.	Albuminous, or flesh-forming principles.	Fatty matters.	Heat-producing principles: Starch, Gum, Sugar, &c.	Woody fibre.	Mineral matters, or Ash.
Sweet-scented Vernal	80·25	2·05	·67	8·54	7·15	1·24
Meadow Fox-tail	80·20	2·44	·52	8·59	6·70	1·55
Tall Oat	72·65	3·54	·87	11·21	9·51	2·86
Yellow Oat	60·44	2 96	1·04	18·66	10·21	2·72
Downy Oat	61·54	3·07	·92	19·16	13 34	2·04
Quaking	51·85	2·93	1·45	27·60	17·00	4·17
Upright Brome	59·57	3·78	1·35	·33	19 00	2·11
Soft Brome	76·62	4·05	·47	9 04	8·46	1·36
Crested Dog's-tail	62·78	4·13	1·32	19·64	9·80	2·38
Orchard	70·00	4·06	·94	13·39	10·11	1·59
Hard Fescue	69·33	3·70	1 02	12·46	11 83	1·66
Meadow Soft	69·70	3·49	1·02	11·92	11·94	1·98
Barley	58·85	4·59	·94	20·05	13·03	2·54
Perennial Rye	71·43	3·37	·91	12·08	10·06	2·15
Italian Rye	75·61	2·45	·80	14·11	4 82	2 21
Timothy	57·21	4·86	1·50	22 85	11·32	2·26
Annual Spear	79·14	2·47	·71	10·79	6·30	·59
June	67·14	3·41	·86	14·15	12·49	1·95
Rough-stalked Meadow	73·60	2·58	·97	10·54	10·11	2·20
Irrigated Meadow	87·58	3·22	·81	3·98	8·13	1·28
Do. second crop	74·53	2·78	·52	11·17	8·76	2·24
Annual Rye	69·00	2·96	·69	12·89	12·47	1·99
Orchard grass, seeds ripe	52·57	10·93	·74	12·61	20·54	2 61

No. 2.—Analyses of Natural Grasses (100 parts of Grass dried at 212° Fahr.)

Names of Grasses.	Albuminous, or flesh-forming principles.	Fatty matters.	Heat-producing principles: Starch, Gum, Sugar, &c.	Woody fibre.	Mineral matters, or Ash.
Sweet-scented Vernal	10·43	3·41	43·48	36·36	6·32
Meadow Fox-tail	12·32	2·92	43·12	33·83	7·81
Tall Oat	12·95	3·19	38·03	34·24	11·59
Yellow Oat	7·48	2·61	47·08	35·95	6·88
Downy Oat	7·97	2·39	49·78	34 64	5·22
Quaking	6·08	3·01	46·95	35·30	8·66
Upright Brome	9·44	3·33	82·02		5·21
Soft Brome	17·29	2·11	38·66	36·12	5·82

* The four following tables were taken from the annual report of the Secretary of the Massachusetts Board of Agriculture of the year 1854.

No. 2.—Analyses of Natural Grasses (100 parts of Grass dried at 212° Fahr.) *Continued.*

Names of Grasses.	Albuminous, or flesh-forming principles.	Fatty matters.	Heat-producing principles: Starch, Gum, Sugar, &c.	Woody fibre.	Mineral matters, or Ash.
Crested Dog's-tail	11·08	3·54	52·64	26·36	6·38
Orchard	13·53	3·14	44·32	33·70	5·31
Orchard grass, seeds ripe	23·08	1·56	26·53	43·32	5·51
Hard Fescue	12·10	3·34	40·43	38·71	5·42
Meadow Soft	11·52	3·56	39·25	39·30	6·37
Meadow Barley	11·17	2·30	46·68	31·67	6·18
Perennial Rye	11·85	3·17	42·24	35·20	7·54
Italian Rye	10·10	3·27	57·82	19·76	9·05
Timothy	11·36	3·55	53·35	26·46	5·28
Annual Spear	11·83	3·42	51·70	30·22	2·83
June	10·35	2·63	43·06	38·02	5·94
Rough-stalked Meadow	9·80	3·67	40·17	38·03	8·33
Grass from irrigated meadow	25·91	6·53	32·05	25·14	10·37
Do., second crop	10·92	2·06	43·90	34·30	8·62

Differences existing in the valuable Constituents of Grasses in this Table as follows:—

	Lowest.	Highest.	Average.
Flesh-forming principles	6·08	17·29	11·68
Fat-producing principles	2·11	3·67	2·89
Heat-giving principles	38·03	57·82	47·92

No. 3.—Analyses of Artificial Grasses as taken from the Field.

Names of Plants.	Water.	Albuminous, or flesh-forming principles.	Fatty matters.	Heat-producing principles: Starch, Sugar, Gum, &c.	Woody fibre.	Mineral matters, or Ash.
Red clover	81·01	4·27	·69	8·45	3·76	1·82
Perennial clover	81·05	3·64	·78	8·04	4·91	1·58
Crimson clover	82·14	2·96	·67	6·70	5·78	1·75
Cow grass	74·10	6·30	·92	9·42	6·25	3·01
Cow grass, 2nd. specimen	77·57	4·22	·07	11·14	4·23	1·77
Hop trefoil	83·48	3·39	1·77	7·25	3·74	1·37
White clover	79·71	3·80	·80	8·14	5·38	2·08
Common vetch	82·90	4·04	·52	6·75	4·68	1·11
Saintfoin	76·64	4·32	·70	10·73	5·77	1·84
Lucerne, or Alfalfa	69·95	3·83	·82	13·62	8·74	3·04
Black Medick, or Nonsuch	76·80	5·70	·94	7·73	6·32	2·51

No. 4.—Analyses of Artificial Grasses, dried at 212° Fahr. (100 Parts.)

Names of Plants.	Albuminous, or flesh-forming principles.	Fatty matters.	Heat-producing principles: Starch, Sugar, Gum, &c.	Woody fibre.	Mineral matters, or Ash.
Red clover	22·55	3·67	44·77	19·75	9·56
Perennial clover	19·18	4·09	42·42	25·96	8·35
Crimson clover	16·00	3·73	37·50	32·39	9·78
Cow grass	24·33	3·57	36·36	24·14	11·60
Cow grass, 2nd specimen	18·77	4·77	49·65	18·84	7·97
Hop trefoil	20·48	4·67	43·86	22·66	8·33
White clover	18·76	4·38	40·04	26·53	10·29
Common Vetch	23·61	3·06	39·45	27·38	6·50
Saintfoin	18·45	3·01	45·96	24·71	7·87
Lucerne, or Alfalfa	12·76	2·76	40·16	34·21	10·11
Black Medick, or Nonsuch	24·60	4·06	33·31	27·19	10·84

DIFFERENCES EXISTING IN THE MOST VALUABLE CONSTITUENTS OF THE GRASSES IN THE PREVIOUS TABLE:—

	Lowest.	Highest.	Average.
Flesh-forming principles	12·76	21·60	18 68
Fat-forming principles	2·76	4·77	3·76
Heat-giving principles	33·31	49 65	41·48

The foregoing tables show the vast disparity that exists in the value of different grasses, either in the green or the dry state. At the same time, it is a question whether a mixture, even of the most inferior species, may not conduce to the health and good condition of the animals which feed upon them. We know that this is the case with ourselves, and that with the most nourishing diet it is necessary to use less stimulating food in order to correct the humours of the system and keep it in health. This, however, does not detract from the importance of the analyses or the value of the tables to the agriculturist, who, in laying down either alternate or permanent pasture, or in improving existing ones, may learn from them the most useful species to employ. They will even enable the large breeders and graziers to make a distinction between pasture for store cattle and that for fattening. The former require flesh-forming grasses combined with those which give heat; the latter require a larger addition of the fat-forming grasses. The predominance of both these principles in the artificial over the natural grasses, is so marked, as to point them out as valuable for both purposes. Take one species, cow-grass, for instance; this grass has of late years been much sought after, its valuable properties having become known. The large proportion of flesh-forming principles and fatty matters, combined with an equal proportion of heat-producing properties, accounts for the high price its seeds maintain in the market, whilst its perennial character points it out as eminently calculated for permanent pasture.

SECTION XIV.

FORMATION OF PASTURES.

THE following tables, taken from Messrs. Lawson's "Agrostographia," show the quantity and kinds of grass seeds required in the formation of different kinds of pastures.

No 1.—FOR ALTERNATE HUSBANDRY.

Names of Grasses.	Light and medium soils.			Heavy Soils.		
	For one year's hay.	One year's hay, and one year's pasture.	One year's hay and two years' pasture.	For one year's hay.	One year's hay, and one year's pasture.	One year's hay, and two years' pasture.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Common Cock's-foot	—	2	2	—	2	2
Italian Rye	9	9	9	9	9	9
Common Rye	15	15	15	15	15	15
Trefoil, or Nonsuch	—	1	1	1	2	2
Timothy	1	2	2	1	2	2
Alsike clover		2	2	1	2	2
Common red clover	8	4	4	8	4	4
Cow-grass	—	2	4	—	2	4
White, or Dutch clover	2	4	4	2	4	4
	36	41	43	37	42	44

In sheep pastures it will be advisable to sow, in addition, 1 lb. per acre of *Petroselenum sativum* (Common Parsley), and in upland districts from 2 lbs. to 3 lbs. per acre of *Plantago lanceolata* (Common Plantain), and from 1 lb. to 2 lbs. of *Medicago cupulina* (Trefoil). In proportion to the retentiveness of the very heavy soils, as well as those of a peaty nature, *Phleum pratense* (Timothy) should also be increased at the rate of 1 lb. or 1½ lb. per acre.

No. 2.—For Permanent Pasture.

Names of Grasses.	Light Soils.		Medium Soils.		Heavy Soils.	
	With a crop.	Without a crop.	With a crop.	Without a crop.	With a crop.	Without a crop.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Meadow Fox-tail	1½	2	1½	2	2	2½
Cock's-foot	4	5	5	6	6	7
Hard Fescue	2	2	2	2	2½	3
Tall Meadow Fescue	—	—	2	2	2½	3
Meadow Fescue	2	3	2½	3½	2½	3½
Creeping Fescue	1	1½	—	—	—	—
Italian Rye	6	7	6	7	7	8
Common Rye	8	10	9	11	10	12
Timothy	1	1	2	3	2½	3
Wood Meadow	1½	1½	1½	1½	1½	1½
Smooth-stalked Meadow	1	1½	1	1	—	—
Rough-stalked Meadow	—	—	2	3	3	4
Trefoil, or Nonsuch	1	1	1	1	1	1
Red clover	1	1	1	1	1	1
Cow grass	2½	2½	2½	2½	2½	2½
Dutch clover, or Suckling	5	6	5	6	6	7
	37½	45	44	52½	50	59

In certain cases, the following additions to the foregoing No. 2 and the succeeding No. 3 tables may be made, viz., ½ lb. to 1 lb. of *Achillea millefolium* (Common Milfoil), in dry sheep pastures · 2 lbs. *Cichorium intybus* (Wild Chicory), in cattle pastures; 6 lbs. to 10 lbs. *Onobrychis sativa* (Sainfoin), and from 4 lbs. to 6 lbs. *Poterium sanguisorba* (Common Burnet), on calcareous soils; 1 lb. to 2 lbs. *Petroselinum sativum* (Parsley), in lands where sheep are subject to the rot. Where a crop of hay is taken the first year, both the *Rye grasses* may be increased one-third, and 2 lbs. *Trifolium pratense* (Red Clover) added. Where occasional crops of hay are to be taken, ½ lb. per acre of *Anthoxanthum odoratum* (Sweet-scented Vernal Grass) should be added to table No. 2.

No. 3.—For Permanent Pasture.

Names of Grasses.	Light Soils.		Medium Soils.		Heavy Soils.	
	With a crop.	Without a crop.	With a crop.	Without a crop.	With a crop.	Without a crop.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Meadow Fox-tail	1¼	1½	1½	2	2	2½
Sweet-scented Vernal	0½	0½	0½	0½	0½	0½
Yellow Oat	1	1	1	1	—	—
Cock's-foot	3½	4	4	5	4	5
Hard Fescue	2	2	2	2½	2	2½
Tall Meadow Fescue	—	—	2	2	2½	2½
Various-leaved Fescue	—	—	2	2	3	—
Meadow Fescue	2	2	2	3½	2½	4
Creeping Fescue	2	2	—	—	—	—
Italian Rye	6	7	7	8	8	9
Common rye	8	9	9	10	9	10
Carried forward	26¼	29	31	36½	33½	36

No. 3.—For Permanent Pasture. (*Continued.*)

Names of Grasses.	Light Soils.		Medium Soils.		Heavy Soils.	
	With a crop.	Without a crop.	With a crop.	Without a crop.	With a crop.	Without a crop.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Brought forward	26¼	29	32	36½	33½	36
Timothy	1½	2	2	2½	2½	3
Wood Meadow	1	1	1	1¼	1¼	1½
Hudson's Bay Meadow	1	1	1	1¼	1¼	1½
Smooth-stalked Meadow	1	1	—	—	—	—
Rough-stalked Meadow	—	—	2	2½	2½	3
Bird's-foot trefoil	1½	0½	0½	0½	—	—
Greater Bird's-foot trefoil	—	—	0½	0½	0½	0½
Common trefoil	1	1	1	1	1¼	1¼
Alsike clover	1½	2	1½	2	2½	2½
Red clover	1	1	1	1¼	1½	1½
Cow grass	2	2½	3	3½	3½	3½
Dutch clover, or Suckling	4	4	4	5	5	6
	41¾	45	49½	57¾	55¼	60¼

No. 4.—For Lands in Preparation for Irrigation.

Names of Grasses.	Light Soils.		Medium Soils.		Heavy Soils.	
	With a crop.	Without a crop.	With a crop.	Without a crop.	With a crop.	Without a crop.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Fiorin	1¾	2	2	2½	2½	2¾
Field Fox-tail	1¾	2	2	2¼	2¼	2½
Slender Fescue	1	1½	2	2	2	2¼
Meadow Fescue	2	2½	2	2½	2	2½
Tall Meadow Fescue	1½	1½	2	2	2	2
Italian Rye	7	9	7	9	7	9
Common Rye	10	12	10	12	10	12
Canary	1	1	1½	2	2	2
Timothy, or Cat's-tail	2	2	2	2¼	2½	3
Floating Meadow	2	2½	2	2½	2	2½
Water Meadow	1	1	1	1	1	1
Rough-stalked Meadow	2	2½	2½	3	3	3½
Greater Bird's-foot (trefoil)	2	2	2	2	2	2
Alsike clover	1	1	1	1	1	1
	36	42½	39	46	41¼	48

The expense of this mixture may be decreased by excluding the Field Fox-tail and half the Giant Bird's-foot grass; but it is desirable to retain the latter, as it is the best adapted of the clovers for withstanding excess of moisture, and for attaining to full maturity at a late period of the season, when general vegetation is less vigorous.

No. 5.—For Permanent Pasture and Hay, in Orchards and other Grounds much overshaded by Trees.

Names of Grasses.	Light Soils.		Medium Soils.		Heavy Soils.	
	With a crop.	Without a crop.	With a crop.	Without a crop.	With a crop.	Without a crop.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Sweet-scented Meadow	1	1	1	1	1	1
Common Cock's-foot	5	6	6	7	6	7
Hard Fescue	2	2	2	2	2	2
Tall Meadow Fescue	—	—	1½	2	2	2
Italian Rye	6	7	6	7	6	7
Common Rye	8	9	8	9	8	9
Wood Millet	1	1	1	1	1	1
Timothy, or Cat's-tail	1	1	1	1½	1½	2
Wood Meadow	2	2	2	2¼	2½	2½
Evergreen, or Hudson's Bay	2½	3	3	3¼	3¼	3½
Rough-stalked Meadow	1½	1¾	2	2¼	2½	2½
Greater Bird's-foot trefoil	2	2	2	2	2	2
Cow-grass	3	3	3	3	3	3
White, or Dutch clover	4	4	4	4	4	4
	39	42¾	42½	47¼	44¾	48½

Where the appearance of coarse-growing grasses is objectionable, the Common Cock's-foot grass, Tall Meadow Fescue, and Timothy may either be lessened in quantity or entirely excluded, and about two-thirds their weight of Hard Fescue grass substituted for them.

No. 6.—For Pasturage and Cover in thick shady Woods and Plantations.

Names of Grasses.	Light Soils.	Medium Soils.	Heavy Soils.
	lbs.	lbs.	lbs.
Creeping Bent	1	1	$1\frac{1}{2}$
Tufted Hair	2	$2\frac{1}{2}$	3
Fibrous-rooted Oat	3	4	5
Wood Fescue	$2\frac{1}{2}$	3	$3\frac{1}{2}$
Giant Brome	3	3	3
Common Cock's-foot	5	6	7
Tall Meadow Fescue	2	2	2
Soft Meadow	1	1	1
Great Bird's-foot	2	2	2
Wood Millet	2	2	2
Timothy, or Colt's-foot	1	1	1
Wood Meadow	2	2	2
Evergreen, or Hudson's Bay Meadow	2	2	2
Rough-stalked Meadow	2	2	2
	$30\frac{1}{2}$	$33\frac{1}{2}$	37

Where covert for game is the chief object, the quantity of Tufted Hair grass, Oat grass, Wood Fescue, Giant Brome, Tall Fescue, and Wood Millet should be increased one-half, reducing those of the Bent, Wood Meadow, Evergreen, and Rough-stalked Meadow in the same proportion. The Wood Millet grass is useful for supplying the game with food with its seeds, as well as shelter. If a fine grassy verdure is wanted, the six exceptional grasses should be increased instead of diminished.

No. 7.—For Heathy and Moory Lands which have been Improved with a View to their Producing Better Pasturage.

Names of Grasses.	With a crop.	Without a crop.
	lbs.	lbs.
Fibrous-rooted Oat	$2\frac{1}{2}$	3
Common Cock's-foot	3	4
Hard Fescue	2	$2\frac{1}{2}$
Sheep's Fescue	1	1
Soft Meadow	2	$2\frac{1}{2}$
Italian Rye	6	8
Common Rye	10	12
Trefoil, or Nonsuch	2	2
Timothy, or Cat's-tail	3	3
Dutch clover, or White suckling	3	4
Cow grass	2	2
	$36\frac{1}{2}$	44

Where the soil is of a moist and peaty nature the quantity of Timothy should be increased, and from 1 lb. to $1\frac{1}{2}$ lb. of Fiorin and Rough-stalked Meadow grass added. If of a dry nature and high altitude, an additional quantity of Hard Fescue and Sheep's Fescue (2 lbs. each) will be found useful, especially for sheeps' pasture; also a few pounds of Common Plantain.

No. 8.—For Marshy Grounds, and those Occasionally Overflowed by Fresh-water Tides.

Names of Grasses.	Alluvial Soils.	Peaty Soils.
	lbs.	lbs.
Marsh Bent (Fiorin)	3	4
Tall Meadow Fescue	4	3
Darnel (Slender Fescue)	4	4
Greater Bird's-foot Trefoil	3	3
Reed-like canary	3	2
Timothy, or Cat's-tail	3	4
Water Meadow	5	2
Floating Sweet Meadow	3	5
Rough-Stalked Meadow	4	5
	34	32

For banks of rivers subject to overflowings, but where the soil is of a dry, porous nature, on an open gravelly subsoil, a mixture approximating to that in table No. 2 may be used, and the Canary grass, Water, and Floating Meadow grasses excluded. These two last are useful in binding the soil on the banks.

No. 9.—For Warrens, or Light Sandy Soils.

Names of Grasses.	Weight.
	lbs.
Yarrow, or Milfoil	1
Creeping Bent, or Twitch	2
Fibrous-rooted Tall Oat	4
Creeping Fescue	4
Creeping Soft	2
Italian Rye	6
Common Rye	8
Common Bird's-foot Trefoil	1
Yellow Trefoil (Nousuch)	4
Sainfoin	4
Smooth-stalked Meadow	3
Burnet	3
Yellow Suckling	2
White, or Dutch clover	3
	47

To which may be added, in certain cases 2 lbs. of Whin and 1 lb. of Broom seed. From 2 lbs. to 3 lbs. of Lucerne seed may also be used where the sand is of a calcareous nature, or mixed with fragments of sea shells. The mixture should be sown with a bushel of barley or rye, for the purpose of sheltering the young plants from droughts and winds, to which they will be exposed in such soils.

SHEEP IN WINTER.

SECTION XV.

THE TURNIP.

There is no certain record or tradition as to the time when the turnip was first introduced into Britain, but it is well understood that it was long cultivated as a horticultural plant before it was adopted in the field. It was known to the Romans in the time of Columella, by whom it was mentioned as both a field and a garden plant; and he recommends the cultivation of it abundantly, because what was not eaten by man, could be advantageously given to cattle; and both he and Pliny agree that, next to corn, the turnip was the most useful and valuable product of the farm. It is, therefore, probable that the Romans brought the turnip to Britain, where it could be cultivated as a garden esculent. If such, however, was the case, the use of it was discontinued, as we learn nothing about it in the middle ages. It again appears as a garden product about the end of the sixteenth century; but no mention of it in field culture is made before the first quarter of the eighteenth century, when Tull speaks of it as cultivated by himself, and estimates that an acre "indifferently hoed," would maintain an ox for nine months. He mentions a vicar's agent who told him that he made £1 an acre of the tithe of a whole field of turnips taken in kind.

It cannot be ascertained in what precise year Tull's work was written; but it is probable that it will correspond with the statement that the field culture of the turnip was first brought over from the Low Countries by the Marquis Townshend, who, about the year 1720, was British ambassador to the States-General. A collateral proof of the truth of this fact is, that the Marquis was a Norfolk man; that that county has ever been noted for the most successful cultivation of this plant; and that the Marquis, as a mark of distinction, was always called "Turnip Townshend." We may, therefore, without any serious error, fix the date of the field culture of the turnip at about the period when the Marquis returned from the Low Countries, where it had been in practice for an unknown period.

There is, however, no question as to the beneficial effects of the introduction of the turnip into British husbandry, and of the entire change it has effected in the management of the land. "No man," says Lord Kames, in the "Gentleman Farmer," "ever deserved better of his country, than he who first cultivated the turnip in his fields."* It is a plant that enriches in every way, instead of impoverishing, the soil. It derives its chief nourishment from the atmosphere and the moisture of the sub-soil, taking but little from the upper soil. Analysis has proved that neither guano nor bone-manure supply much of the elements of which the turnip is composed, although a very small quantity of either of these manures produces a wonderful effect in stimulating its growth. This arises from the faculty these manures possess of attracting to the soil the carbon and nitrogen of the atmosphere.

On the other hand, the proper cultivation of the turnip, has, of itself, an ameliorating effect upon the soil, independent of the quantity of manure raised by the consumption of the crop. The fine tilth to which it is necessary to reduce the land, in the first instance, in which to deposit the seed; the frequent hoeing the plant requires to keep it clear of weeds, and to open the soil to the influence of the air and light; the depth to which the roots penetrate, thereby loosening, to a certain extent, the subsoil;—all these operations form the best preparation of the land for the future corn crops; and this is so well known in the turnip districts, that the loss of that crop is a serious calamity. "No turnips," they say, "is equal to no barley, no clover, no wheat." In other words, it causes a failure of the whole course, unless extraordinary means are adopted to counteract the injurious consequences.

The soil and climate of Great Britain, especially the northern parts, are both admirably adapted to turnip culture. In Scotland particularly, it has from the first, been an object of the farmer's most sedulous attention; and some of the very best types of the root have been raised in that part of the kingdom. The turnip husbandry was adopted by the Scottish farmers at an early period, and prosecuted even with more vigour there than in England. Dr. Hunter in the "Georgical Essays," when expressing his surprise that it was not more practised in England, states that he knew only one farmer who had cultivated the turnip on an extended scale, and he was a Scotchman, who grew 100 acres of them. It is true the land being to a great extent uninclosed and consisting of "town lands," which were common after the grain crops were removed, was against the cultivation of root, as well as artificial grass, crops. The Scotch farmers adopted the Norfolk course of husbandry—namely, turnips, barley, clover, wheat—which is still the favourite course of cropping with them.

The turnip belongs to the *Brassica* tribe of plants (*Brassica rapa*), a species of which grows wild in Britain; but all attempts to produce a bulb from it by cultivation have

* "Gentleman Farmer," p. 135.

hitherto failed, so that it is worse than useless, being a troublesome weed. The following is the chemical analysis of the Common White Loaf turnip, made by Professor Dr. Lyon Playfair:—

Of 100 lbs. there was, water 90°, protein 1°, carbonaceous matters 9°, from which may be seen the small proportion of its substance derived from the earth, and how little nourishment it contains. The Swedish turnip, or *Ruta baga*, is of a more solid nature, and contains a larger proportion of carbonaceous or saccharine matter than the common turnip. The leaves of the Swedish turnip are of a dark bluish green colour, and the root, being more solid, grows more slowly, but stands the winter better than the White Loaf. The Swedes fatten animals fed upon them quicker, but cows fed with them give less milk. They are of a less laxative nature; and it is considered that twenty tons of Swedes are equal in nutritive power to twenty-five tons of the common turnip. It is a remarkable fact, ascertained by experiment, that land on which the common turnip and the Swede have been sown in the same field and treated precisely in the same manner, produced a better crop of corn after the latter than after the former. The Swede, however, requires better land or higher culture than the common turnip, although both will pay best with the latter. The Swede was first introduced into Scotland about the year 1777, from Sweden, and was first cultivated by a farmer of the name of Airth. The following analysis of a crop of 20 tons or 45,000 lbs. is given by Stephens:—

	lbs.
Woody fibre	·900
Starch, Gum, Sugar	4·000
Gluten	·670
Fat, or Oil	·130
Saline matter	·300
Water	39·000
	45·000

The turnip requires a light friable soil and a mild humid climate; the west of Scotland and Ireland are therefore peculiarly suited to its cultivation. In the latter country very large crops are grown, and the bulbs frequently attain a great size when they are properly cultivated and hoed. Forty, fifty, and even sixty tons per acre are spoken of by some of the best Irish farmers in the neighbourhood of Dublin, but the generality hoe them in a very inefficient manner, and some we have known who never hoe them or thin them at all, merely pulling out the charlock and other weeds that rise above the turnips. A better system of husbandry begins to prevail in all parts of that country, stimulated by the different agricultural institutions established by the government, and especially by the Royal Dublin Society for the improvement of agriculture.

The number of varieties of the turnip plant are endless, partly the result of new stocks raised by individuals from single turnips of superior excellence, and partly from the carelessness of seedsmen in not properly selecting the roots from which their seed is raised, and also in purchasing seed from farmers who grow it from bulbs not transplanted or selected. This latter is a very general practice, and cannot be too severely condemned and punished, for it is a punishable offence. We have known an instance in which, owing to the purchase of bad seed, the seller was glad to escape a series of prosecutions by payments to the amount of more than a thousand pounds. The injury, in fact, extends far beyond the mere loss of the turnip crop, and can scarcely be estimated too high.* A large farmer will always do well to grow his own seed from carefully selected bulbs, taking equal pains to prevent them from hybridizing with other varieties, by keeping them distinct.

Morton reckons six distinct species of the turnip, as follows :—

1. The Swedish turnip, with eleven varieties.
2. The Common Field, with ten „
3. The Purple top Yellow, with three „
4. The White turnip, with seven varieties.
5. The Green-top White, with six „
6. The Red-top White, with four „

1st. The Common Purple-top Swede (*Brassica campestris ruta baga*) is considered to be the original of nine out of the ten varieties of the Swedes, Laing's being the exception. They are as follows :—

1. The Common Purple-top.
2. The Ballantyne „
3. The Skirving's.
4. The Improved Skirving's.
5. The Ashcroft's.
6. The Fettercairn's.
7. The Laing's.
8. The Common Green-top.
9. The Cox's New Imperial.
10. The Victoria New Pink-top.
11. The Green-top White.

2nd. The Common Field turnip has the following varieties :—

1. The Yellow Aberdeen Bullock.
2. The Hood's Large Green-top Yellow.
3. The Gordon's Green top Yellow.
4. The Pollexfen's „
5. The Old Scotch Yellow.
6. The Gibb's Imperial Scotch Yellow.
7. The Lawrencekirk Yellow Tankard.
8. The Cambridgesbire „
9. The Dale's Hybrid.
10. The Fosterton's Hybrid.

3rd. The varieties of the Purple-top Yellow are :—

1. The Common Purple-top Yellow.
2. The Border Imperial „
3. The Skirving's Imperial Purple-top.

4th. The White Loaf turnip has the following varieties :—

1. The Common White Globe
2. The Pomeranian „
3. The White Stone „
4. The Snowball „
5. The Autumn, or Six Weeks.
6. The White Norfolk.
7. The White Tankard.

5th. The Green-top White turnip :—

1. The Green Globe, or Green-top White.
2. The Stent's Improved.
3. The Lewisham Green-top Ox-heart.
4. The Green Norfolk.
5. The Green Tankard.
6. The Lawton's Hybrid.

6th. The Red-top White turnip varieties are :—

1. The Red Globe.
2. The Red Norfolk.
3. The Red Tankard.
4. The Woolton's Hybrid.

The Swedish turnip has for many years been gaining ground over every other

* It is, however, a remarkable fact that, since the appearance of the potato diesase, the Swedish turnip has shown a decided disposition to return to its original state of rape. This has been proved in numerous instances by persons who have sown the purest seed in two fields; in one, nothing but rape was produced, whilst in the other the bulbs were as good as those from which the seed was raised.

species throughout the United Kingdom, for late feeding especially. Of all the varieties of the Swedish, Stephens considers the Purple-top to be the best and most profitable to cultivate. The upper part of the bulb is of a dull red colour; the texture is firm and solid. It stands the northern winter well, and loves a black or loamy soil, on which it yields a large produce. Skirving's Improved Purple-top has a fine root, that takes but slight hold of the ground. It is of an oblong shape, has a longer neck, stands more out of the ground, and does not keep so well when allowed to remain out during the winter. It is a free-grower, matures early, and keeps well in store. It grows well on a shallow or hard clay soil, and it yields a better and heavier crop than any other variety of the Swede.

The Yellow Aberdeen Bullock turnip is a well-known variety. It requires good land, and must not be sown too early. Laing's variety has a large leaf, like that of a cabbage, and, by covering the soil, prevents the growth of weeds. It is thought to be superior to all other varieties, not excepting Skirving's; but being a late turnip, and not a heavy producer, it has not gained ground in Scotland. Morton, however, considers it worthy of attention, especially in the south of England, and in Ireland, where the early winters are milder. It does not run to seed in the autumn, and is a fortnight later in the spring before it pushes its new leaves and flowering stems.

The Common Purple-top Yellow turnip has a deep yellow bulb below, and reddish purple at the top, a globular shape, dark green leaves, streaked with red veins. It produces a bulky crop, and is adapted to an inferior soil, but is equal in quality to the Green-top variety.

The Common White Globe is an early variety, well known. The colour is white, skin smooth and uniform, neck and tap-root. It requires to be set out closer than other kinds, because if set wide apart it grows large, and is apt to rot. It frequently produces 40 tons per acre, and is at maturity in September or October, and is therefore the first that is ready for feeding the cattle. The White Norfolk turnip is called by Morton "a large, coarse variety," producing a very heavy crop, but is apt to rot, owing to the crown being hollow. The White Stone Globe is the hardiest of all the White Loaf varieties of the turnip. It has a small bulb, which grows deep in the ground, is rounder in shape, and rougher in the skin than the Common White Globe. It stands the winter better than any other of the common turnips.

The Green Globe is a large free-growing turnip, of a good shape and texture, a small neck and tap-root. Yields a heavy crop. The Red Globe is an old variety, cylindrical in shape, of a dull red colour, whitish towards the root. It is adapted to a poor and peaty soil, but it grows to a large size on good land. The Red Tankard is only fit for poor land, on which it produces a better crop than the other red varieties.

Stephens recommends that, in arranging for a turnip crop, so much only of the White Loaf species should be sown or stored as will last the live stock till the end of the year; the Yellow Globe should follow next for two months, say till the end of February; and lastly, the Swede should then finish the season, or until the grass is sufficiently forward for the stock to be turned into it. This is doubtless a good arrangement so far as *young* stock are concerned; but for a flock of ewes, many of which may be old and croned, the Yellow Globe and the Swede turnips would be too hard for them to be able to feed upon, and the White Loaf is the only turnip upon which they can possibly subsist. Even this is, in some cases, found too solid, especially when in a frozen state in the field. The White Globe is reckoned the best for early maturity, sweetness, juiciness, size of bulb, weight of crop, and fineness of form. It has a thin and smooth skin, with an oily appearance, and perfectly white. The neck and tap-root are small. The quantity of nutritive matter in the same species differs with the soil in which they are grown. Professor Johnstone found, upon analysis, that in one thousand there were 42 lbs., namely, mucilage 7, sugar 34, albumen 1, or rather more than four per cent. The same eminent chemist gives the following analysis of turnips grown on three different soils:—

	1.	2.	3.
Water	89·30	89·43	89·00
Sugar	5·61	6·21	6·54
Gum	·11	·10	·36
Albumen	·72	·47	·30
Pectic acid	1·75	1·33	1·57
Oil	·19	·22	·18
Cellular fibre	1·63	1·75	1·39
Saline matters	·54	·49	·59
	99·86	100·00	99·93

These analyses show a large proportion of saccharine matter, the kind being the Purple-top Swede, which contains at least as much, if not more, of that material than any other kind of turnip, or even root, except the sugar-beet. The quantity, however, of saccharine varies in both turnips* and beet-root, according to the latitude in which they are grown, and invariably increases as they go further north.

The following are the analyses of three kinds of turnips, by Dr. Voelcker, of the College at Cirencester:—

	White Globe.		Norfolk Bell.		Swede.	
	Natural state.	Dry state.	Natural state.	Dry state.	Natural state.	Dry state.
Water	90·430	—	92·280	—	89·460	—
Flesh-forming materials	1·143	11·940	1·737	22·525	1·443	13·662
Fat-producing materials	7·799	81·490	4·962	64·250	8·474	80·248
Inorganic substances	·628	6·570	1·021	13·225	·623	5·910
	100·000	100·000	100·000	100·000	100·000	100·000

The specific materials of the same were as follows:—

	White Globe.		Norfolk Bell.		Swede.	
	Natural state.	Dry state.	Natural state.	Dry state.	Natural state.	Dry state.
Water	90·430	—	92·280	—	89·460	—
Sugar, Gum, Pectic acid, &c.	4·697	49·080	2·137	27·657	4·637	44·024
Albuminous substances	1·143	11·940	1·737	22·525	1·443	13·662
Vegetable fibre, &c.	3·102	32·410	2·825	36·593	3·837	36·404
Inorganic substances	·628	6·570	1·021	13·225	·623	5·910
	100·000	100·000	100·000	100·000	100·000	100·000

* The amount of nutritive matters vary with the soil: the White Loaf from 8 to 13 per cent., and the Swedes from 11½ to 17 per cent., but the small roots almost invariably contain the largest proportion.

The inorganic substance, or ash, was found to contain the following matters in one hundred parts:—

Potash	36·78
Soda	6·96
Chloride of potassium	·59
Chloride of sodium	7·85
Magnesia	3·61
Lime	11·14
Phosphoric acid	9·74
Sulphuric acid	12·43
Silica	3·43
Peroxide of iron	1·09
Carbonic acid	6·38
	100·00

The specific gravity of various species is:—

The Orange Swede in December	1·005
,, in June, after flowering	·940
The White Swede	1·022
The Yellow Bullock	1·940
The White Globe	·840

It has been asserted of late years by agriculturists of standing and eminence, that the turnip and other root crops are so far from being profitable to the farmer, that when all expenses of cultivation and attendance upon the cattle are taken into the account, the balance-sheet would show a heavy loss at the end of the season, without reckoning the loss of animals by accident or disease, which is frequently also very heavy; and they argue from this, that farming would be more profitable if they could dispense with root crops and cattle grazing altogether, so far as the winter is concerned, the bullock shed being, at best, only a manure manufactory, and the cattle the working machines in it.

This, however, is a very narrow view to take of the question; because, if it is admitted that the *direct return* for the expense of raising a turnip crop and consuming it by bullocks is usually very small, and probably may sometimes exhibit a balance on the wrong side of the page, those expenses ought in fairness to be spread over the whole course of crops, which receive a double benefit, in the better condition and cleanness of the land, and in the unexhausted manure in the soil after the turnips are removed. If we add to these the conversion of the straw into manure of a far superior quality to what was formerly made by lean cattle, it needs no calculation whatever to prove that the turnip husbandry is the basis of agricultural prosperity; and we see the proofs of it in the condition of the land, as well as of its cultivators, as compared with what it was before the alternate culture and the turnip husbandry were introduced.

It is not always, however, that cattle winter grazing is unprofitable, or attended with a loss; and at the present, which seems likely to be the permanent, price of beef and mutton, we might expect to find the reverse to be the case, and that independent of the collateral advantages, there would be a direct profit upon the consumption of the turnip or mangold crops. If we estimate the whole expense of raising them, in round numbers, as averaging £9 per acre (which we belive to be not far from the truth), that quantity of Swedes will fatten a bullock of from 60 stone to 70 stone, that may be purchased at any of the fairs at Michaelmas for £14. When fat, it will fetch 8*s.* per stone, or from £24 to £28, which certainly will entail no loss on grazing. We have, however, given the extreme cost price of the lean animal, which may frequently be purchased for £12 or £13; but the above estimate is sufficient to show that cattle grazing is not necessarily or invariably a losing game. If corn or cake are employed, the fattening process will be hastened, with a corresponding decrease in the consumption of the turnips, so that it will benefit rather than injure the account.

SECTION XVI.

THE MANGOLD-WURZEL.

The botanical name of this plant is *Beta vulgaris*, and there are five varieties of it cultivated in the United Kingdom, namely, the Orange Long, the Orange Globe, the Long Red, the Globe Red, and the Silesian, or Sugar Beet. This latter is not at present much grown in England, its valuable fattening properties not being so well known here as they are in France.

It is the opinion of Professor Anderson that the mangold-wurzel is much more nutritive than the turnip. On analysing a crop of 35 tons of this root, he found that it contained at least three times the nutritive matter of an average crop of turnips. Whether this refers to the common turnip or the Swede we are not able to state. The superiority, however, must probably be ascribed to the greater amount of sugar contained in the beet-root, there being but little difference in the proportions of water and solid matters, as the following analyses by Professor Sullivan of Dublin will show:—

Species	Water.	Solid matters.	Sugar.
Long Red mangold-wurzel . . .	84·520	15·480	9·62
Globe ,, ...	83·630	16·370	10·70
Orange Globe ,, ...	85·974	14·026	9·00
White Silesian beet	81·530	28·470	12·60
Swedish turnip	85·060	14·940	7·53

It is proper to observe that the proportion of saccharine matter in the mangold-wurzel as well as in the Silesian beet varies very much, according to the soil, climate, and cultivation. In 125 analyses of the sugar-beet made by Professor Sullivan, he found it to range from 2·699 to 14·551 per cent., both crops having been highly manured for with farm-yard dung. Climate has, perhaps, the most to do with the difference. It is found in France that the beet-root cultivated in the south does not contain enough saccharine to make it answer the purpose for manufacturing sugar; but that the further north it proceeds, the larger proportion the root contains. The specimens operated upon by Professor Sullivan were grown in various parts of Ireland, the climate of which is peculiarly favourable to the production of root crops of all kinds. It is difficult, therefore, to account for the large difference in the amount of saccharine contained in the two extreme cases referred to, except that the last was grown in the county Tyrone and the other in Cavan—which lies more to the south, certainly, but not so much so as to account for the great difference. The following are the analyses of different kinds of beet, made by Professor Johnstone :—

	Mangolds.			Silesian Beet.	
	Long Red.	Short Red.	Orange Globe.	Long Red.	Short Red.
Water	85·18	84·68	86·52	85·13	84·68
Gum	0·67	0·50	0·13	0·67	0·50
Sugar	9·79	11·96	10·24	9·79	11·97
Casein	0·39	0·26	0·33	0·39	0·36
Albumen	0·09	0·18	0·03	0·09	0·18
Fibre, Pectin, and Pectic Acid	3·08	3·31	2·45	3·08	3·31
	99·20	100·90	99·70	99·15	101·00

	Mangolds.		Silesian Beet.	
	Natural state.	Dry state.	Natural state.	Dry state.
Flesh-forming principles	1·81	13·03	2·83	15·50
Heat-giving substances	11·19	80·04	14·38	78·07
Mineral constituents	0·96	6·93	1·18	6·43
Water	86·04	—	81·61	—
	100·00	100·00	100·00	100·00

The analyses of two species of mangold-wurzel, bulb and leaves, made by Professors Way and Agston, are as follows :—

	Yellow Globe.		Long Red.	
	Bulb.	Leaves.	Bulb.	Leaves.
Potash	23·54	8·34	29·05	27·53
Soda	19·08	12·21	19·05	5·83
Lime	1·78	8·72	2·17	9·06
Magnesia	1·75	9·84	2·79	9·10
Oxide of iron	0·74	1·46	0·56	0·48
Carbonic acid	18·14	6·92	21·01	6·11
Phosphoric acid	4·49	5·89	3·11	4·39
Sulphuric acid	3·68	6·54	3·31	6·26
Chloride of sodium	24·54	37·66	14·18	23·85
Silica	2·22	2·35	4·11	1·35
Ash	1·02	1·40	1·00	1·91
	99·96	99·93	99·94	99·96

It has been ascertained by analyses that small mangold-wurzels and beet-roots contain a larger proportion of solid materials and sugar than larger ones. "The size of the bulb," says Sir Robert Kane, "has a remarkable influence upon the amount of sugar which the beet contains, or rather upon the relation between the solid matter left on drying the root, and the water driven off. An examination of Table I shows in a very remarkable manner, that the larger the root grown in the same field is, the smaller is the quantity of solid matter which it contains. Thus No. 23 weighed 3 lbs. 9½ oz., and yielded 14·383 per cent. of solid matter, whilst No. 29, which weighed but 15 oz., yielded 19·337 per cent.* And as the per centage of sugar contained in the dried matter

* This refers to a table containing the 125 analyses just mentioned. See Report of Inquiry into the Composition and Cultivation of the Beet-root in Ireland, by Sir R. Kane.

does not vary very much, being, except under very peculiar circumstances, a little under or a little over two-thirds of its weight, it will be found that the quantity of sugar will diminish as the weight of the bulb increases; No. 28, for instance, contains but 9·885 per cent. of sugar, and No. 29, 12·132 per cent. *This rule may be considered to hold good for all roots, no matter where grown;* although good cultivation, a suitable soil, and proper manures, may enable one farmer to produce roots of a larger size containing more solid matter, and therefore more sugar than much smaller ones grown by another under less favourable circumstances. Thus all the roots which yielded a very low per centage of sugar, weighed from five to nine or ten pounds, while those remarkable for the quantity of sugar they contain, were always small roots, seldom exceeding 2 lbs. in weight." The report then refers to a table containing analyses of Russian roots by Hermann, two eminent chemists, the results of which were as follows:—

Weight of bulb. Oz.	Per centage of sugar.
3	12·7
6	11·5
8 to 10	11·1
9 to 13	11·96
10	10·1
15 to 23	12·13
21	10·27
26 to 28	10·3
27	7·66
32 to 56	6·7

This question of size, applied by Sir R. Kane to *all* roots, is a most important one to the farmer. It has been the object with many persons to grow large bulbs, both of turnips and mangolds, by giving them as much room as possible to develop themselves. It is shown by experiment and analysis that, taking weight for weight, a crop of small bulbs will produce a much larger amount of nutritive matters than one of large bulbs, which can be attained by planting the seed closer. This principle is so well understood in France, where the Silesian beet-root is cultivated so largely for manufacturing sugar, that the growers plant them at seven or eight inches distance from plant to plant, and about fourteen inches from row to row, the bulbs seldom exceeding two and a half or three pounds' weight, and many not more than one pound and a half.

The mangold-wurzel is well adapted for spring feeding, whether for sheep or cattle. It has been found that the proportion of sugar goes on increasing until the flowering stem begins to be formed, after which it decreases, being transferred from the bulb to the seed. Early sowing is generally considered favourable to the crop; but it is liable to suffer if late frosts should take place after the plant has made its appearance above the ground. For this reason it is less cultivated in Scotland than it is in England and Ireland, the late spring and the early winter frosts being alike injurious to its early stage of growth and when matured. The southern districts of England are well suited to this plant; and the growers are said to find it easier to raise 30 tons of mangold than 20 tons of turnips. The milk and butter from cows fed upon the mangold have no disagreeable flavour, as from turnips. The mangold is also extensively cultivated in the eastern counties, where, under the four-course husbandry, large crops of it are grown.

Although the mangold-wurzel has been known in England for a long series of years, it has not been much cultivated as a field plant until within the last forty or fifty years. The late Dr. Lettsom knew its value, and used every effort to promote its field cultivation, but did not succeed. Even so late as the year 1816, a writer in "Rees' Cyclopædia," in speaking of it, says, "This root is chiefly valued for its leaves, for which it is principally cultivated in gardens, as we cannot recommend it for its root, which, although it grows large, is greatly inferior to the turnip;" and again, "The great objections to this vegetable as a field plant, are the heavy expenses of its cultivation, its being liable to degenerate, and the fibrous nature of its roots rendering their preparation as cattle-food troublesome." Lord Kames does not mention this plant in his "Gentleman Farmer," nor does Darwin in "The Philosophy of Agriculture." Forsyth refers to it, but treats it as a plant scarcely known as a field production in the United Kingdom, though common in Germany. Marshall, in his "Rural Economy of Norfolk," says not a word about it, and we conclude from this circumstance that in his time it was unknown, or the Norfolk farmers would surely have cultivated it.

It is therefore only within about forty years that the mangold-wurzel has taken its place in British agriculture, and the progress that it has made in the estimation of the farmers is the best evidence of its worth. It is found to fatten cattle faster than the common turnip, and even than the Swede, whilst its sweet juice renders it peculiarly acceptable to milch cows, which produce abundance of milk when fed upon it. One strong recommendation of its culture is its freedom from the attacks of insects, none of the various tribes of which having yet been found to touch it. This is no mean advantage over the turnip, when we compare the perfect immunity of the one with the destructive ravages suffered by the other, and the great expense, as well as loss of crop, that are so frequently occasioned by them. And as to the greater expense of its culture, it does not amount to more than about *5s. 6d.* per acre, and consists chiefly in the extra trouble of storing and preserving the roots. All descriptions of animals are fond of both the bulb and the leaves, and the latter, if properly preserved, form no inconsiderable item in the value of the crop.

The Sugar Beet (*Beta vulgaris cicla*) has hitherto attracted little attention in England, being considered by the farmers as adapted rather to the manufacture of sugar than to the feeding of cattle. It is evident, however, from the large proportion of saccharine matter it contains, that it is equally useful in the latter application with the common mangold, and that it will fatten faster than even that or the Swedish turnip. Some specimens grown in Ireland were found, on analysis by Dr. Sullivan, to contain 19½ per cent. of solid matter, and 13·240 per cent. of sugar, the Long Red mangold showing only 15·480 of solid matter, and 9·62 of sugar. The bulbs of the Sugar or Silesian beet-root have hitherto been smaller than those of the mangold; but being planted much closer, the number grown on the acre is greater, and they possess higher fattening properties. It is possible, however, to raise as large a crop of the Silesian beet as of the mangold by high culture. The result of inquiries by the Commissioners in Ireland gave the produce at from 18 tons to 42 tons per acre; and in one case, that of Lord Talbot de Malahide, it was from 48 tons to 52 tons per acre, the size of the roots ranging from 3 lbs. 8¼ ozs. to 6 lbs. 2 ozs., the largest containing the smallest proportion of saccharine matter. We would strongly recommend the English farmers to try an experiment how far it exceeds the common mangold in fattening properties. In America it has been tested; and Mr. Moore, the President of the State Agricultural Society of Michigan, has ascertained that the Sugar Beet is by far the most profitable root for milch cows, and another eminent farmer, who has cultivated it for many years, declares it to be more nutritious than any other root except the carrot.* The seed should be procured from France or Belgium, the growers in those countries being much more particular in having the best quality of the different species, which are kept perfectly distinct. Such attention has been paid to this plant on the continent for the purpose of the sugar manufacturers, that one grower has succeeded in raising the proportion of sugar in the bulb to 17 per cent., which is equal to that of the West Indian sugar-cane.

SECTION XVII.

KOHL-RABI.

This remarkable plant, which is denominated by the botanists *Brassica oleracea caulo-rapa* of Candolle, was originally brought from Lapland, but has for many years been cultivated in Germany. It was not introduced into British agriculture till the year 1837, but it was previously known by naturalists as a field plant; for in a work now before us ("Gleanings from Books on Agriculture and Gardening"), published in 1802, is a full and accurate description of it, and the method of its culture. The writer mentions two species of it, one of which he calls the Turnip cabbage; this, he states, came from the Cape of Good Hope, having "probably" been taken thither from China, where it is extensively cultivated, and called by the natives *Pack-so-a*. The other, that which we are about to describe, called the Turnip-rooted cabbage is, as we have stated, a native of Lapland; and while the first is used as an esculent for the table, both are valuable for feeding cattle and other herbivorous animals.

The Kohl-Rabi, or Turnip-rooted cabbage was, as we have stated, first brought into public notice as a field vegetable in 1837, when a Surrey farmer (Mr. Hewitt Davis) commenced cultivating it on his farm; and having discovered its valuable qualities, has, we believe, continued to grow it with increasing satisfaction and profit. It is considered far superior to the Swedish turnip in many respects. Cattle, horses, sheep, and pigs are fond of it, and the leaves are more valuable than those of the Swede. It transplants as readily as any other cabbage. No insects will attack it. It stands severe drought without injury or ceasing to grow; it bears stormy weather better than the Swede; it stands the English winter better, and it affords feed later into the summer, even in June.† The following analyses were taken of the Kohl-Rabi by Voelcker:--

	Water.	Ash.	Ash of dry plants.
Bulbs	88·24	·95	8·09
Leaves	84·89	2·80	18·54

* "Year Book of American Agriculture for 1855-6," p. 336.

† Stephens' "Book of the Farm."

The ashes contain the following proportions:—

	Bulbs.	Leaves.
Silica	0·82	9·57
Phosphoric acid	13·46	9·43
Sulphuric acid	11·43	10·63
Carbonic acid	10·24	8·97
Lime	10·30	30·31
Magnesia	2·36	3·62
Peroxide of iron	·38	5·50
Potash	36·27	9·32
Soda	2·84	—
Chloride of potash	—	5·99
Chloride of sodium	11·90	6·66
	100·00	100·00

Stephens questions whether it produces so large a crop of bulbs as the Swede; but the Surrey farmers appear to raise quite as large a bulk of them, and the size of the bulb is from 8 lbs. to 10 lbs.; while, in Ireland, where it has been long cultivated as a field crop, they obtain bulbs of from 10 lbs. to 14 lbs. weight, the soil and climate of that country being peculiarly favourable to its growth. Two varieties are cultivated, the Green and the Purple. The Green is considered the most productive, whilst the Purple contains more nutriment. It is considered to be a variety of the common cabbage, the bulb being only an expansion of the upper part of the stem, probably accidental in the first instance. The bulb itself is a pulpy substance, something like the Swedish turnip. The Germans eat it in common, boiled like the cabbage or turnip; but it is coarse and harsh, and not at all to an Englishman's taste. Sheep are extravagantly fond of it, and begin at the crown, eating first the inside, which they scoop out clean, and then devour the rind. The bulb is of a globular form.

The soil best suited to the Kohl-Rabi is a light, sandy loam; and it thrives well on uplands and wolds. Although there is an idea that the climate of Scotland is too cold for it, experiments have recently proved that it may be safely cultivated in that country. Those who have grown it in England, consider it quite a hardy plant, and much more readily come at in a deep snow than the turnip. The bulbs may be kept in a barn or shed till the spring. If allowed to remain in the field, they will throw out abundance of succulent sprouts in the spring, affording excellent food, when cut and allowed to wither, for cows, sheep, and lambs. If given to them fresh, they are apt to scour them. The Surrey farmers obtain three crops, namely, one planted for the fallow the beginning of May or even the middle of April, and transplanted about the beginning of June; another, where the early potatoes are taken off, and a third on the wheat-stubble, after harvest. By this means they obtain a regular succession of most valuable food in spring and early summer. The butter from the milk of cows fed on this plant is as high-coloured and free from any disagreeable flavour as grass butter. It is planted in rows three feet distant, and the plants at two feet from each other in the rows. An instance is recorded of 140 sheep being kept a month on one acre of the Kohl-Rabi. The weight of crop is from 20 tons to 26 tons per acre, and the land should be prepared the same as for turnips. The best way of cultivating them is by sowing on a seed-bed, and transplanting them the same as the Drum-head and other cabbages. Half a pound of seed thus sown on three square perches of ground, will raise plants enough for an acre. If sown where they are to stand, they are apt to run too much to stalk.

SECTION XVIII.

THE PARSNIP.

The parsnip (*Pastinaca sativa*) is indigenous in England, and grows wild on the highways and hedges throughout the country. In its wild state its root is small, and possesses a pungent disagreeable taste, which entirely disappears when cultivated, and the whole plant undergoes a complete change. There are, in fact, three varieties, the Field or Garden parsnip, the Wild parsnip, and the Cow parsnip (*Heracleum spondilitum*); but the first only is cultivated with us. The last is termed Hog-weed, from pigs being very fond of it, which is also the case with all other herbivorous animals.

The Field parsnip is a very valuable plant, possessing highly nutritive properties. When given to cows they yield abundance of rich milk, the butter from which has a peculiarly fine colour and flavour. It is said that a lean ox will fatten in three months when fed upon parsnips, with a little hay daily. The quantity a three-year-old ox will eat is about 90 lbs. per day given at three meals. The following is Dr. Voelcker's analysis of the parsnip:—

	Natural state.	Dry state
Water	82·050	—
Vegetable fibre	8·022	44·691
Inorganic matters attached to fibre	·208	1·159
Insoluble albuminous matters	·550	3·064
Soluble casein	·665	3·704
Nitrogen in the form of ammoniacal salts	·033	·184
Pectin and gum	·748	4·166
Salts insoluble in alcohol	·455	2·535
Sugar	2·882	16·055
Salts soluble in alcohol	·339	1·888
Starch	3·507	19·537
Fatty oil	·546	3·041
	100·005	100·024

The ash contains the following, as analysed by Dr. Richardson:—

Potash	36·12
Soda	3·11
Magnesia	9·94
Lime	11·43
Phosphoric acid	18·66
Sulphuric acid	6·50
Silicic acid	4·10
Phosphate of iron	3·71
Chloride of sodium	5·54
Charcoal and loss	·89
	100·00

The nutritive properties of the parsnip are as follows:—

	Natural state.	Dry state.
Nitrogenised matters, capable of forming flesh	7·30	7·25
Substances not containing Nitrogen, fitted for the support of respiration, and the formation of flesh	9·65	87·18
Ashes	1·00	5·57
Water	82·05	—
	100·00	100·00

The parsnip differs from the carrot in its composition in having more starch and less sugar. The carrot also contains a larger proportion of water and less nutrition than the parsnip. The yield of this root varies, according to the soil and culture, from 10 tons to 20 tons per acre. Le Couteur says that in Jersey it ranges from 13 tons to 27 tons, the soil being a rich sandy loam. He considers the latter quantity will support twelve Jersey cows for six months, with a mixture of mangold and turnip. This allows each cow about 28 lbs. of parsnips per day. The most important points in the cultivation of the parsnip are the comminution of the soil and deep tillage. These are indispensable to its success. All stones must be picked off, as they materially interfere with the perpendicular striking of the roots downward. Weeds, also, must be carefully removed as fast as they appear. April is the proper time to sow them, which is best performed by the drill, steeping the seed beforehand, in order to quicken the germination. About 10 lbs. of seed is sufficient for an acre. The drills should be eighteen inches asunder, and the plants set out at ten inches in the rows.

The parsnip is subject to the attacks of several species of insects, as the *Parsnip miner* (*Tephritis onoperdonis*). This fly is hatched in May and June, and it feeds upon the *parenchyma* (or pulp) of the leaf, which it blisters, but does not materially injure the root. The *Depressaria pastinacella* is a moth that produces a caterpillar about the time the parsnip is in flower, which it attacks, and destroys the flowering stem entirely.

It is generally supposed that the parsnip requires a strong, dry soil, but this is an error, for, although it will thrive on such a soil if it be well tilled, the best land for it is a free, open, loamy soil, with abundance of manure, and free from stagnant water. It will even grow in a sandy soil under certain conditions, and produce a good crop, if the land is marled and well manured. It is a most valuable root, and deserves more attention from the farmers than it has hitherto received, chiefly, we believe, because it involves rather more trouble than the turnip or mangold. One good property it possesses is, that it takes no injury if left on the ground all winter. If stored, it should be dug up when the leaves begin to decay. These should be cut off three or four days before the roots are laid up, which should be in sand in a dry place.

The leaves are dangerous to handle, especially in a morning when the dew is upon them. They then raise blisters in the hands, full of scalding liquid, which continues troublesome for many days. During the times of popery, the consumption of parsnips, as an accompaniment of salt fish, on fast days, was very great; but it was not then cultivated as a field plant for feeding cattle, but only as an esculent for the table. It is still used with salted pork and beef, as well as with salt fish.

SECTION XIX.

THE CARROT.

Two kinds only of the carrot are cultivated in this country—the Common Orange carrot (*Daucus carota*), and the White Belgian carrot, which is a variety of the same species. The common carrot, which is also called the Altringham carrot, has been cultivated to a certain extent as a field plant, in some districts of the kingdom, for many years; but its culture was not very extended in Arthur Young's time, for he speaks of it as being scarcely known, except in the light sandy districts of his own county of Suffolk, where it had been introduced from Holland or Belgium. It was, however, cultivated extensively in Bedfordshire, in the neighbourhood of Sandy, and sold to the horse-keepers of the neighbouring towns at the close of the last century. Since the crop of potatoes has been rendered so precarious from the visitation and continuance of the disease, the carrot has come much more into notice, and is now superseding that plant in many of the light-land districts, where a good crop of turnips is not easily obtained. Arthur Young strongly advises the farmers of such soils to substitute the carrot for the turnip as being more valuable and useful.

All descriptions of herbivorous animals are very fond of carrots. Horses will thrive upon them, and keep in health in the stable, and in working condition, with very little corn. One bushel per day is the usual allowance for a working farm-horse, with oats. The carrot is especially good for broken-winded horses. The tops have sometimes been made into hay, by cutting them off with a scythe at the latter end of June; and those of a good crop have produced as much as four tons of hay. They should be cut above the crown, and taken off the field to a pasture-ground, to be made into hay. The following is the analysis of carrots by Dr. Way:—

	Roots.	Leaves.
Silica	1·19	4·56
Phosphoric acid	8·55	1·67
Sulphuric acid	6·55	6·20
Carbonic acid	17·30	17·82
Lime	8·83	32·64
Magnesia	3·96	2·92
Peroxide of iron	1·10	2·40
Potash	32·44	7·12
Soda	13·52	10·97
Chloride of Sodium	6·50	13·67
	99·94	99·97

Another by Hermstadt:—

Sugar and colouring matter	6·30
Manna	1·50
Gum	1·75
Oil	0·35
Albumen	1·10
Woody fibre and starch	9·00
Ashes, water, and a heavy oil	80·00
	100·00

In a crop of 25 tons, or 56,000 lbs., there are of—

	lbs.
Husk and woody fibre	1·680
Starch, sugar, &c.	5·600
Gluten, &c.	·840
Oil or fat	·200
Saline matters	·800
	9·120

Arthur Young sums up the excellent qualities of the carrot in the following manner :—

"1st. A team of horses cannot, in any other way, be fed so profitably as on carrots. Allowance, with chaff, 2 bushels per day per horse. If a bushel of oats per week is allowed, then give only 1 bushel of carrots per day. An acre of 400 bushels lasts a horse 200 days, if fed on them without corn.

"2nd. They are excellent for all kinds of stock; pigs, swine, and weaned pigs they fatten well.

"3rd. No food is superior to them for fattening oxen.

"4th. Nor for feeding young cattle and milch cows.

"5th. They fatten sheep profitably."

The White Belgian carrot has of late years been introduced into England, and is found a more valuable root than the Altringham carrot. It is rather shorter, large at the crown, and rapidly decreasing to a point. It is a more certain crop than the Yellow. The root grows wholly underground, and so escapes the depredations of the game, which are excessively fond of it, as well as of the Yellow. This latter is partly above ground, and is thus easily eaten off by hares and rabbits.

In the spring of the year, when the Swedes and mangolds begin to lose their quality, the carrot is particularly valuable before the grass comes in. It acts as an alterative with much more and better effect than medicine, the use of which it supersedes; and it imparts that gloss to the coats of horses and other animals, which, when natural, is the best outward indication of health.

The crop of carrots varies in amount, according to the condition of the land and the season, from 250 to 900 bushels, of 70 lbs. each, per acre. They are best sown after turnips, on account of the clearness of the land from weeds. They may be left in the ground all winter without injury, but are generally taken up and stored on account of the greater convenience in using them in frosty weather, when the ground is too hard to raise them. The tops are cut off, and are equally as valuable for cattle and sheep, as the roots. They should be taken up in dry weather, and left in the field in small heaps, covered with the tops, to weather before storing. Lord Kames states, on the best authority, that at Partington, in Yorkshire, twenty working horses, four bullocks, and six milch cows, were supported on three acres of carrots, from the end of September to the 1st of May, tasting no other food except a little hay; and thirty hogs were fattened upon the refuse left by the other animals. The same fact is mentioned in the seventh volume of "Communications to the Board of Agriculture." Allowing 70 lbs. of carrots per day to the horses and cattle, it would give a produce of nearly 65 tons per acre. This, however, Lord Kames considers almost incredible, 20 tons being considered an excellent crop. The carrot is chiefly used for feeding horses, and for this reason is most cultivated in districts from which there is ready access to the metropolis and other large places, where they sell at from 10*d.* to 1*s.* 2*d.* per bushel of 70 lbs., at which price they yield a large profit.

SECTION XX.

THE JERUSALEM ARTICHOKE.

The botanical name of this root is *Helianthus tuberosus*, the French name being *Topinambours*. There is no soil in which this plant will not grow; but it delights most in a loose sandy loam, where it can throw out its runners without obstruction. Hitherto it has met with but little encouragement from the English farmer, although in France it is much cultivated. The chief objection to it is the difficulty of extirpating it after it has been once planted, the smallest piece of the tuber being sufficient for its propagation.

The Jerusalem artichoke is said to be a native of South America; but whether of Chili or Peru is not known, nor has it been ascertained who first brought it to Europe, although it is said to have been cultivated in Alsace about the same time that the potato was introduced. Brogniart is of opinion that it came originally from the northern part of Mexico. It derives its name of artichoke from the flavour of the tuber being like that of the artichoke; but why it is called the Jerusalem artichoke is entirely unknown. It belongs to the same family of plants as the dahlia and the sunflower, but it seldom flowers in our climate, and is always propagated by cuttings of the tuber. The roots spread just below the surface of the soil, and the tubers are formed around the stem, of very irregular shape and size, being in colour of a reddish yellow. In a dry soil its rough outside protects it from frost, but if exposed on the surface of the ground it freezes. It grows rapidly, which is ascribed to the robust organisation of the leaves and stalks, which enables them to receive, retain, and quickly assimilate the humidity supplied by the atmosphere. The following is the chemical composition of the tubers as ascertained by the analysis of M. Braconnet:—

Saccharine matter	14·80
Inuline	3·00
Gum	1·22
Albumen	0·99
Fatty substances	0·09
Citrate of potash and lime	1·15
Phosphate of potash and lime	0·20
Sulphate of potash	0 12
Chloride of potassium	0·08
Malates and tartrates of potash and lime	0 05
Woody fibre	1·22
Silica	0·03
Water	77·05
	100 00

Composition of alimentary Vegetable Substances of the Tubers.

Water	79·20
Phosphates and other salts	1·40
Woody fibre and cellulose	1·20
Fatty matters	0·30
Starch, sugar, or analogons matters	16·10
Albumen, legnmin, casein	2·10
Azote	0·33
	100·73

Its nutritive equivalent, deducted from the azote, is as 318 to 100 of hay.

Nutritive matters, non-azotised in excess, in the equivalent, 9.

From this statement it appears that there are 3½ times the nutriment of hay in the Jerusalem artichoke. The proportion of 14⅘ per cent. of saccharine accounts for this, and proves it to be superior in fattening properties to the Swedish turnip and the mangold-wurzel. It contains, in fact, 79·2 per cent. water, and 20·8 of dry matter.

The ash, which values 6 per cent., is constituted as follows, according to Boussingault :—

Carbonic acid	11·0
Sulphuric acid	2·2
Phosphoric acid	10·8
Chloride	1·6
Lime	2·3
Magnesia	1·8
Potash	44·5
Soda, traces only	—
Silica	13·0
Oxide of iron, alumine, &c.	5·2
Carbon, moisture, and loss	7·6
	100·00

The absence of salts of soda is very remarkable. In temperate climates the Jerusalem artichoke seldom produces a flower, and never any seeds, which proves that it belongs to the tropics, or, at least, to regions approaching thereto. Notwithstanding this, its cultivation as a field product is profitable, and much more certain than that of potatoes. It will grow in the lightest sand, in which the potato will scarcely succeed. It is propagated by cuttings or small bulbs, each set having a bud. When well manured with farm-yard manure, it will yield from 260 to 320 bushels per acre, or from 8 to 10 tons. About 56 lbs. of tubers per acre are enough for planting, at the distance of twenty-seven inches between the rows and nine inches from plant to plant, and about three or four inches deep. The stalks are quite as acceptable to cattle as the roots; and in France they sometimes cut them twice, and make them into hay. This, however, detracts from the crop of tubers to the full value of the hay from the stalks; and it can only be useful to practise it in the case of a failure of the regular hay crop.

The French call this root the "Pear of the Earth" (*Poire-de-terre*), in contradistinction to the potato (*Pomme-de-terre*); and "the manna of poor soils," as it grows where no other alimentary plant can be cultivated to advantage, requiring little manure. It is subject to no attacks of noxious insects whilst growing, but rats and mice will devour it if they are allowed to get to it when stored or left in the ground. It is chiefly used in feeding and fattening pigs, but should be mixed with other food. Sheep, too, are fond of it, and fatten fast upon it. A correspondent of the *Journal d'Agriculture Pratique*, states that he purchased eighty sheep on the 3rd of March, put them upon half a hectare, (1 acre, 37½ poles) of Jerusalem artichokes, and sold them fat on the first of May. They cost him 20 francs (16*s*. 8*d*.) each, and he sold them at 28 francs each (23*s*. 4*d*.), so that they paid a gross sum of £26 13*s*. 4*d*. for less than five roods of the tubers.* The expenses amounted to £11 13*s*. 4*d*. including tillage of every kind, attendance, harvesting, &c., leaving a clear profit of £15 or £12 per acre. The same land was cropped fifteen consecutive years with the same plant, and the *average profit* was fully equal to that of the first year. No manure was put on the land; and after the first year it seeded itself with what was left in the ground.

The best and cheapest way to fatten pigs on this plant is, to turn them into the field and let them raise the tubers with their snouts. This will save the expense of raising and storing, and will be quite as effectual, if not more so, in clearing them out of the ground, which appears to be the chief difficulty in the way of its cultivation.

* *Journal d'Agriculture Pratique*, April 5, 1858.

SECTION XXI.

THE CABBAGE.

The Drumhead, or Cow cabbage (*Brassica oleracea capitata depressa*), is the one chiefly cultivated as a field plant, although the Savoy and other sorts are sometimes used for the same purpose. There is a difference of opinion as to the comparative fattening qualities of the cabbage and the Swedish and other turnips; but there is none as to the superiority of the former for milch cows, in producing an abundance of milk. If the outer leaves are left on the cabbage, they are apt to give a taste to the milk, as they are frequently partially decayed. These, however, if taken off, will be eaten by the young cattle; and if the heart only is given to the cows, the milk and butter will be as free from any unpleasant flavour as if they were fed on grass. The Drumheaded cabbage, if plenty of room is allowed, will grow to a large size, some having reached as much as 90 lbs. Some plant them 18 inches every way, but it is better to give them from 3 to 4 feet between the rows, and from 24 to 30 inches between the plants in the rows. By this means they have full room to develop themselves, and attain a much greater aggregate weight than when planted close.

The charge against the cabbage, that it does not fatten cattle so fast as the turnip, does not appear to be consistent with the properties of the two plants. The cabbage is more astringent than the turnip; and we know that as an esculent for the table, it possesses great nutritive power. It is a very productive plant, and more certain than the turnip, not being liable to so many enemies in its early stages of growth. Arthur Young, in his tour of six months, made ample inquiries into the value of the crop of cabbage, and found that the general average weight of produce on all soils, of the Drumheaded variety was 36 tons per acre. Forsyth states that as much as 68 tons per acre was obtained by Mr. Vagg, for which he received a premium from the Bath Society. In giving them to fatting cattle and cows, great care is necessary in avoiding to give any that are decayed, either outwardly or at the heart, as they certainly impart a disagreeable flavour to both the meat in one case, and the milk in the other. Dr. Priestley states that the air of a room was rendered noxious by one cabbage leaf remaining in it for one night, though the leaf did not exhibit any appearance of decay.

Cabbages sometimes require to be twice transplanted, being apt to run too much to stalk, if the land is rich and the weather moist. A friend of ours once saw some fine cabbage plants lying withering on a bed in a garden, and asked the gardener if they were useless. "Oh, no," he replied, "they are too *rankarous*, and we serve them so to take the consate out of them." This is a good hint as to the treatment of such plants in certain seasons, perhaps in all, as the plants are very apt to "run away." The cabbage delights in a strong, free soil, well manured. With such conditions, the crop will generally be very heavy and full-hearted. It stands the winter better than the turnip, and comes in well for spring-feeding. The cabbage, however, will accommodate itself to almost any soil, and even on a sandy gravel; but on this the crop will be proportionably lighter. The following are the analyses of the cabbage, taken by Professor Johnstone; from 80 to 92 per cent. of water, and from 7 to 20 per cent. of inorganic or mineral matter. The ash, according to Fromberg's analysis, consists of—

Potash	11·70
Soda	20·42
Lime	20·97
Magnesia	5·94
Oxide of iron	0·60
Phosphoric acid	12·37
Sulphuric acid	21·48
Chlorine	5·77
Silica	0·75
	100·00

Its nutritive composition is as follows :—

Nitrogenous or flesh-forming ingredients	1·75
Non-nitrogenous, or heat-giving matters	4·05
Mineral matters	0·80
Water	93·40
	100·00

A crop of 20 tons of cabbages takes from the soil the following amount of mineral matters :—

	lbs.
Potash	105
Soda	184
Lime	189
Magnesia	54
Oxide of iron	5
Phosphoric acid	112
Sulphuric acid	192
Chlorine	52
Silica	7
	900

Coleworts or Rapes (*Brassica rapus*) are cultivated extensively in fenny countries, partly for the support of sheep in spring, and partly for the value of the seeds in the manufacture of oil and cake, the latter for manure. As food for sheep, they are chiefly of use for the ewes after lambing, producing an abundance of milk; but if the season is wet, they are apt to scour the ewes, unless dry food is given with them. Coles will grow on almost any land; and very poor soils have produced from 12 to 18 bushels of seed per acre, whilst good land will yield double that quantity in a favourable season. They do not injure, but rather improve the land. The necessary hoeing cleans it in the first instance, and being a "smothering crop," it effectually prevents the weeds from growing afterwards.

The cultivation of rape is very extensively carried on in the Netherlands, the soil of which is peculiarly suited to it. It is used both for feeding cows, and for raising the seed, of which they obtain large crops. It is generally first grown on a seed-plot in April, and transplanted in June or July, allowing a square foot to each plant. It is very hardy, and no frost will injure it.

SECTION XXII.

THE POTATO.

There is no material difference of opinion respecting either the country from whence the potato was first brought into Europe, or the person who introduced it. It is a native of South America, and was brought into the United Kingdom by Sir Walter Raleigh, who cultivated it in his own garden in Ireland, or by some of the persons who accompanied him in his expedition thither. Gerard has fallen into an error in stating that it was a Virginian plant, and that he received it direct from that part of North America. There is, however, some confusion in his account, as he describes two varieties,—the *Sesarum Peruvianum*, or the "Skirrets of Peru," and the *Battata Virginiana*, or *Virginianorum Pappas* (Virginian potato). Peter Cicca, on the other hand, in his chronicle, printed in 1553, states that the inhabitants of Quito and its vicinity cultivated a tuberous plant, which they called "*Papas;*" and Clusius of Vienna considered it to be the same plant of which he received a specimen from Mons in Hainault in 1593, and which was cultivated and eaten in Italy under the name of Taratoufli; but it was not known there whether it came from Spain or America. Sir Robert Southwell, in 1693, declared, before the Royal Society, that his grandfather brought it first into Ireland, having procured it from Sir Walter Raleigh. Sir Joseph Banks supposed that it was taken into Ireland so early as 1584 by the colonists direct, because Herriot, the chief of the expedition, sent out by Sir Walter Raleigh, wrote an account of it, under the name of Openawk. "These roots," he says, "are round, some as large as a walnut, others much larger. They grow in damp soils, many hanging together, as if fixed on ropes. They are good for food, either boiled or roasted." Humboldt is of opinion that in no part of North America, or in the West India Islands, is the potato indigenous.

In the "Journal of the Society of Arts," vol. x. p. 25, it is stated by Lambert, on the authority of Don Jose Pavon and Don Francesco Zea, that the potato (*Solanum tuberosum*) grows wild in Chili, Peru, and the environs of Lima; also in the forests of Santa-fé-de-Bogota; and a specimen was sent to Lambert by Pavon, procured by him in Peru. Humboldt confirms these accounts by stating that it grows wild in abundance, in the fields of Chili, and is called by the natives *Maglia*. He adds, "they do not cultivate it, the tubers being small and bitter." Commerson also states that he gathered the *Solanum* near Monte Video; but his description of it does not correspond with that of the *S. tuberosum*. He brought it to France, where it was called the *S. Commersonia;* but it is very little known, except to botanists.

The most conclusive authority on the subject is Alexander Coleleugh, Esq., who resided for a long time at Rio Janeiro, as Secretary to the British Embassy. He found the wild *Solanum tuberosum*, growing in profusion in the ravines of the immediate neighbourhood of Valparaiso, on the western side of South America, in lat. 34½° south. Its tubers are small, and have a bitter taste, as described by Humboldt. Some of them are red, and some white; and Mr. Coleleugh was of opinion, that "it grows over a large extent of the country; for in the south of Chili it is found, and called by the natives *Maglia*, but it is not used by them for food." Two tubers of this plant were presented to the Royal Society, and being planted on a border they grew luxuriantly. Not having thrown out tubers in August, they were then earthed up; after which they formed abundance of shoots. The stalks were seven feet long, and they produced 600 tubers of various sizes, from that of a pigeon's egg downwards, resembling in flavour a new potato.*

We have gone thus far in the ancient history of this important plant, whose advent and adoption has had so powerful an influence on society, especially in Ireland, where, what would have been a most useful *auxiliary* article of diet, has proved the cause of a large portion of the numerous physical evils which afflict that country, through making it almost the exclusive food of the peasantry. The consequence has been, that whenever a failure of the crop of potatoes occurred, the rural districts were involved more or less in famine and distress. The years 1846, '47, and '48 brought a climax of misery, by the repeated failure, during those years, of the potato crop; and by famine, fever, cholera, and emigration, the population was in three years reduced to the extent of two millions. Notwithstanding this, the class of cottier farmers still cling to its cultivation; and the warnings they have had (in the recurrence, almost annually, to a greater or lesser extent, of the disease) of the danger they incur by continuing to make it the main source of their support, have no effect whatever. They cherish its history, and show with pride and triumph, the garden in which it is said Sir Walter Raleigh first cultivated it; and they cling to its use as to the "staff of life," which, in fact, it is constituted by them.

Independent of the impolicy of trusting for support to one article of food, at once of the lowest and most precarious kind, the moral consequences of such a course are bad. In Ireland, the effect has been to retard industry and civilisation, and to reduce the peasantry to the lowest condition of human existence. Even Swift, with all his predilections in favour of Ireland, was constrained to acknowledge the degraded state in which the rural population lived. "The families of the farmers," said he, "live in filth and nastiness, upon buttermilk and potatoes." This was a hundred and fifty years ago, and every writer on that country, from then up to the present time, confirms, to a certain extent, the description; although in some districts, and in Ireland generally, a great improvement has been going on the last ten or twelve years. But the frequent recurrence of scarcity arising from the failure of the potato, reduces the peasantry to a normal condition of poverty and beggary, utterly subversive of that independence of character, which is the foundation of moral improvement.

Next to Ireland, Lancashire is, perhaps, the greatest stronghold of the potato cultivation in the United Kingdom. It is remarkable that its introduction into that country was accidental, a vessel containing a cargo of potatoes being cast away on its coast; it has ever since been noted for the abundance and good quality of those grown there. In other parts of England its progress was slow until the beginning of the eighteenth century; nor has it ever become a principal article of food in this country, with any considerable portion of the people. In Scotland, prejudice was strong against it until about the year 1728, although attempts had been made forty years previously to bring it into favour. That it was at length adopted was owing to the persevering efforts of a day-labourer, Thomas Prentice, who was the first person that planted it in

* A writer in the "Le Nouveau Dictionnaire Classique d'Histoire Natural," states that the *Solanum tuberosum* was brought from Peru to the Province of Betangas, in Galicia, about the year 1530, where it became acclimated, and was called *il Castana Marina*, or the Marine Chestnut.

the open field at Kilsyth, in Stirlingshire. The success attending his attempts led the farmers and cottiers to follow his example. They purchased their seed from him, by which he was enabled to accumulate £200; with this sum he secured an annuity, and lived in comparative comfort the remainder of his life. In both England and Scotland the potato is eaten as a vegetable auxiliary to animal food, very few of the peasantry being compelled by poverty to live upon it, as is the case in Ireland. In this way it forms a valuable addition to the daily meal, and an excellent *succedaneum* when the high price and scarcity of wheaten bread presses heavily upon the labouring classes.*

In France it was at a much later period that the potato obtained a national footing. So early as 1588 L'Eclure, of Arras, published a description of it, and called the attention of the French cultivators to it, as likely, at some future period, to prove "a great resource to humanity." Gaspard Bauhin mentioned it in 1592, and was then the cause of its introduction into Switzerland, Suabia, the environs of Lyons, the Vosgian Mountains, and other parts; but a violent clamour was raised against it from an absurd report that it caused the leprosy. In consequence of this charge it made no progress in France for upwards of a century. "It was disdained and repulsed by all imaginable means; and after having been pursued with the cruelly powerful arm of ridicule, they finished by accusing it of containing the most active of all the poisons furnished by the *Solanum* family. In the meanwhile, some rural proprietors attempted, in the year 1713, to cultivate it on a large scale, but the effort failed from some cause now unknown. Fifty years after, it appeared in certain tabular accounts, in which it was confounded with the *Batata*, of the Antilles, and the *Topinambour*, or Jerusalem Artichoke, of Brazil. The peasants of the Apennines had long before this used it at table instead of bread, whilst on the rest of the continent of Europe, it was still employed solely in fattening cattle.† It was not till the year 1780, according to the same authority, that the cultivation of the potato began to be extended in France. About that period an enterprising and intelligent man of the name of Parmentier, being convinced that the prejudice existing against that plant was wholly unfounded, determined to make an effort to bring it into general cultivation. He had already, in 1773, began the attempt; and braving the senseless opposition he met with, exploded the sophisms of his opponents, disregarding the clamour raised by folly, calumny, and insolence, from all quarters. He made plantations on an extended scale on the Plains of the Sablon and Grenoble, and obtained a guard of soldiers to protect him by day, whilst at night, the protection being withdrawn, the tubers were stolen by the peasantry, who having learned to appreciate their value, were desirous of cultivating them secretly. Notwithstanding this drawback, the 28 hectares (about 69 acres), taken promiscuously on those vast sandy plains, then uncultivated, and stimulated by no manure, "yielded, in the following autumn, thousands of sacks of valuable tubers, almost as substantial food as the purest wheaten bread.'‡

From this period the prejudices of the people began to subside; and in the disastrous season of 1785-6, when the wheat crop in France fell short by one-third of an average, and forage was so scarce that thousands of cattle died of starvation and disease, the

* The first time the potato was brought prominently before the British public as a national product was in the year 1662, when a letter from a Mr. Buckland was read before the Royal Society, in which he recommended its general cultivation throughout the United Kingdom, "to prevent famine." It was more than twenty years after this that it came into use as a substitute for bread, when, a scarcity being apprehended, people began to eat it at their dinner-tables instead of bread.

† "Nouveau Dictionnaire Classique d'Histoire Natural." ‡ Idem.

potato, so far as it had been cultivated, was found a seasonable relief, and from that time its cultivation spread rapidly throughout France, the tuber bearing the name of its promoter "Parmentier." "In the years 1795, 1806, and 1817," says the writer in the "Dictionnaire," "it saved France from the horrors of famine, and now takes the position it will for ever maintain, amongst the most healthful, palatable, and certain aliments for both rich and poor. In the first of these periods scarcely 86,000 acres were appropriated to the cultivation of the potato in the whole kingdom of France. In 1815 it occupied 863,825 acres; and twenty years later the breadth of land rose to about 2,100,000 acres. It has the inappreciable advantage of producing, upon a given extent of land, more nutritive matter than any other alimentary plant. On a half hectare, manured with dry leaves, and planted with potatoes, we nourish twice the number of men as on five hectares of wheat. The stalks reduced to ashes furnish abundance of potash, the flowers yield a fine yellow dye, the starch taken from it is nourishing, and may be made to enter into every confection for rich and poor. Mixed with wheat, we obtain from it excellent bread; and by fermentation and distillation it yields superior brandy."

In Austria, between 300,000 and 320,000 acres of land are appropriated to the culture of potatoes for the express purpose of supplying the agricultural distilleries, of which there are 16,000 in that country. These are worked to the utter demoralisation of the rural population, who are tempted, by the offer of credit, to purchase the brandy, by the landowners, who are also the proprietors of the distilleries. A more innocent and useful application of the potato prevails also in Austria, in the manufacture of starch, sugar, and vinegar. The sugar is made from the starch, and the process will be described when we come to treat of agricultural manufactures at a future portion of the work. The following is the composition of the potato, according to the analyses of Professor Johnstone:—

	Natural state.	Dry state.
Water	75·52	—
Starch	15·72	64·
Dextrine	0·55	—
Sugar	3·30	15·
Albumen, Casein, Gluten	1·41	9·
Fat, or Oil	0·24	1·
Fibre	3·26	11·
	100·00	100·

The following are the analyses of the ashes of different kinds of potatoes made by Boussingault and Fromberg:—

	Boussingault.	Fromberg.		Average.
		Lanarkshire.	Drummore.	
Potash	59·95	57·58	49·73	55·75
Soda	traces	3·66	1·93	1·86
Lime	2·09	0·81	3·31	2·07
Magnesia	6·28	4·53	5·03	5·28
Oxide of iron and alumina	0·59	0·42	0·56	0·59
Phosphoric acid	13·16	9·98	14·58	12·57
Sulphuric acid	8·27	14·63	18·04	13·65
Chlorine	3·14	5·16	4·51	4·27
Silica	6·52	3·68	2·49	4·23
	100·00	100·45	100·18	100·27

The potato is not only now cultivated in every country of Europe and Asia, but to a certain extent in America, and in all our colonies. The soil, however, of the United States does not appear to suit it, nor will it produce a good quality of the tubers. The experiments on the State Farm of Massachusetts, in 1855, resulted as follows:—

Potatoes manured with barn-yard manure . . .	86½	bushels per acre.
,, ,, ,, superphospbate	84¾	,, ,,
,, ,, ,, ,, (another kind)	77½	,, ,,
,, ,, ,, guano	92½	,, ,,

The value of the manure in each case was twelve dollars (£2 10*s.*), the average produce 85¼ bushels, which, reckoning 70 lbs. to the bushel, gives 2 tons 13 cwt. 24 lbs. The authority from which we quote says, "As to quality, some will be tough and watery, some dry and mealy; some very pleasing to the taste, while others will not be palatable." These are all raised from the same seed, and show plainly enough that the plant cannot have been a native of the northern continent of America. If the expenses of seed and tillage are added to the value of the manure, the crop must sell high to realise a profit. In fact, Russell states that potatoes, in some parts, are dearer by the bushel than wheat, the ordinary price being one dollar (4*s.* 2*d.*) per bushel of 70 lbs., or at the rate of £6 13*s.* per ton. When they are manured for very highly, the crop is much larger, especially if guano is used at the rate of 400 lbs. or 500 lbs. per acre; but the quality is inferior in all cases to that of the European tubers.

In India, the potato was unknown until the British obtained a footing in the country. It met the most violent opposition from the Brahmins as an innovation not sanctioned by their creed. It is now considered one of the greatest boons conferred upon the natives by their new rulers, and it is fast superseding rice in their estimation. In the periods of famine, which so frequently occur in the history of that country caused by the failure of the rice, from the want of rains, the potato has proved of great service to the starving populations, who find it contains more solid nourishment than rice. Bishop Heber was of opinion that one-fourth part of the bulk of rice eaten by the natives, in potatoes, will satisfy hunger better, and be more nourishing. When we consider that the relative proportions of starch in the two species of food is 70 per cent. in rice, and about 16 per cent. in potatoes, and that starch, in itself, affords no nourishment to support life, the bishop's opinion appears correct. The potato is now naturalised in every part of British India, where the soil is favourable to it. The neighbourhood of Patna, in which it was introduced in 1790, is particularly suited to its culture, and that of all other European vegetables. The tubers are smaller than with us, but in flavour and quality they are quite equal to ours.

In Ceylon, there is only one district at present known to be favourable to the cultivation of the potato or any other European vegetable. This is the part round the city of Candy, seventy miles from Columbo, the European capital and seat of government. A basket of potatoes used to be sent over every morning expressly for the governor's table.* The luxuriance of the soil, and the tropical climate, are unfavourable for the proper development of the tubers. Samuel Bate, Esq., one of the first emigrants who settled in Van Diemen's Land, took out with him half a bushel of potatoes, *all of one kind.* These he planted, and on taking up the crop, was surprised

* Heber's "Journal."

to find *five distinct varieties*, namely, the White Champion, the Red Lancashire, the Kidney, a small round new kind, and a variety called at home the "Miller's Thumb." They were all of excellent quality; but, a sample of each being sent into a tropical climate by way of experiment, they were planted, and the product of all proved a degenerate type of the original variety.

This tendency to sport, or change its quality and species, is one of the most remarkable characteristics of the potato. Without any perceptible cause, such as hybridising or otherwise, it is impossible for any cultivator of this plant, in raising it from seed, to calculate, with any certainty, upon what kinds he may find amongst produce from the same apple. M. Sargeret, a French grower, produced from the seed of the same plant three hundred varieties, not one of which was similar to the parent plant, and only three of the number were found to be worth preserving as stock. This inveterate tendency to depart from the parent plant when raised from seed, is a conclusive argument against that mode of procedure, except for the express purpose of procuring fresh varieties. That it is no protection against the disease, was proved in 1850, when some seed was procured from South America, the produce of which was found to be equally liable to that fatal blight as that raised from the old stocks of Europe.

There is nothing more perplexing to the naturalist than that the slight difference existing in the composition of different plants should produce so wide a disparity in their characteristics and usefulness to mankind. Take, for instance, the produce of the wheat and potato plants, and we find in them the following primary elements:*—

	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ashes.
Wheat	46·1	5·8	43·4	2·3	2·4
Potatoes	44·0	5·8	44·7	1·5	4·0

With such apparently trifling differences in their component elements, we might expect to find some analogy in the characters of the two plants, and yet nothing can be more dissimilar. In the wheat the farina is found in the seed, whilst in the potato it is lodged in the tubers proceeding from the root. Wheat, again, is a dry plant, containing a very small proportion of water. On the contrary, although the components of water in the two are within 1·3 per cent. of each other, the dry material in the potato is by far the smallest part, as the following table shows.

In one hundred parts of these substances, in their ordinary state of moisture, are found:—

	Wheat.	Potatoes.
Dry material	85·5	24·1
Water	14·5	75·9
	100·0	100·0

With regard to the actual amount of nourishment contained in a crop of potatoes, however inferior it may be in point of quality to that of wheat, there is not a question that it yields more than any other plant whatever; and were it a more durable and less

* Kane's "Industrial Resources of Ireland."

perishable production, it would stand very high amongst, if not at the head of, those vegetables which constitute the basis of human sustenance. The experience of the last fourteen years has taught us that no dependence can be placed upon the potato as a crop, the repeated return of the disease, with more or less virulence, every year, having dissipated all hope of any means being discovered of effectually guarding against it.

Independent of this, however abundant a crop of potatoes may be, they cannot be stored in their *natural state* so as to be preserved, like grain, beyond the season in which they are harvested. Like the manna of the Israelites, whatever are kept over the season of their growth, will decay; and they must therefore either be eaten by man or the inferior animals, or converted into starch before, or soon after, the period of reproduction comes round. This constitutes one of the most serious objections to the substitution of the potato in lieu of cereal plants. The following tables will show the comparative quantity of human food yielded per acre by wheat and potatoes:—

	As stored.	Dried.
	lbs.	lbs.
Wheat	1,500	1,285
Potatoes	14,500	3,500

And these contain the following proportions of the most nutritive substances:—

	Starch and Sugar.	Gluten.	Oil.
	lbs.	lbs.	
Wheat	825	185	45
Potatoes	2,613	434	45

Thus, while the proportion of starch in wheat is 55 per cent., and of gluten 12 per cent., the potato contains of starch about 18 per cent., and of gluten not quite 3 per cent., taking both productions as stored.* Notwithstanding this, such is the fecundity of the potato, that the crop contains per acre three and a half times as much starch and sugar, and two and one-third times as much gluten, as a crop of wheat—the quantity of oil in each being equal per acre.

With respect to the nutritive power of the potato, as compared with other vegetable food, and especially wheat, there is a considerable difference of opinion existing. Taking weight for weight, the latter is unquestionably of the most intrinsic value, as is proved by the large proportion of water in the potato, and also the enormous quantity an adult individual labourer will consume at a meal.† That the potato will, alone, sustain life in full vigour, is proved by the Irish peasantry. The rural constabulary of that country are all taken from amongst the cottier farmers, who subsist chiefly on potatoes and

* "The substance of the potato consists of a compact mass of cells or small bladders, held together by the fibrous parts. These cells contain the starch in its perfect state; and in order to detach it from them, each of them must be broken. Their very minute size (from 150 to 200 to the inch) renders this a matter of difficulty to effect, so as to extract *all* the starch. In fact, a portion of it always is left in the pulp, no process having yet been discovered that was sufficiently delicate to touch all the cells. This is of the less consequence where the pulp is economised, as it is so much the more valuable for feeding cattle in proportion to the quantity of starch it contains."—See Griffith and Henfrey's "Microscopical Dictionary," article STARCH.

† Seven pounds of potatoes is no uncommon allowance for a dinner.

buttermilk; and many of them, whilst young at home, do not taste animal food or wheaten bread half a dozen times in the year; yet a finer body of men are not to be found in any country in Europe. A *corpulent* man is seldom seen in Ireland; but tall, athletic, and well-formed men are far more common there than in England. We question whether the average height of the Irish peasantry is not from one to two inches more than that of the English.

The evil, then, accompanying the excessive cultivation of the potato in Ireland, arises from their making a precarious production the sole dependence for supporting life. And when its perishable nature, which peremptorily forbids the formation of a reserve (however abundant the crop may be) against a future scarcity, is added to the danger of a failure, it will at once be seen that the potato was never intended to constitute "the staff of life," as it has been in Ireland. "Its vast productiveness," says a French writer and traveller, "has multiplied potatoes in Ireland so as to form the basis of the subsistence of the entire country. *That is an evil;* for a social condition, where each family, or nearly each individual, has his field, which furnishes his immediate nutriment, without any necessity for marketing, without the assistance of the miller or the baker, without occasion to demand assistance from his neighbours, that society is deficient in the elements most necessary to the progress of civilisation."*

We have no statistics of the breadth of land employed in the growth of the potato in England or Scotland; but those of Ireland prove that, as soon as the alarm created by the famine of 1846, '47, and '48 had subsided, the people returned to its cultivation with as much eagerness as ever. The following are the particulars extracted from the annual returns of agricultural produce for that country:—

Number of Acres Employed in the Cultivation of Potatoes in Ireland from the Year 1853 to 1862 inclusive:—

Years.	Acres.	Increase.	Decrease.
1853	808,733	—	—
1854	989,660	180,927	—
1855	982,301	—	7,359
1856	1,104,704	122,404	—
1857	1,146,920	42,216	—
1858	1,159,706	12,786	—
1859	1,200,144	41,438	—
1860	1,171,837	—	28,307
1861	1,123,201	—	48,636
1862	1,017,317	—	105,884

The increase, therefore, in 1862 over 1853, is 208,584 acres; but it ought to be stated that there is a corresponding increase in the cultivation of wheat, to the extent of 30,920 acres, as the following will show; the decrease in both kinds of produce in the last five years of the term is owing to the increase in the cultivation of green and root crops by the large farmers, and *their* abandonment, and not that of the cottier farmers, of the potato culture. The same cause has also added largely to the extent of cultivated ground, coupled, as it has been, with the operations of the Board of Works, under the Arterial Drainage Act, by which several hundred thousand acres have been reclaimed from swamp and bog, or laid dry and rescued from periodical floods. The extent of these latter in the Valley of the Shannon alone amounts to more than 30,000 acres, of which

* De Jonnes.

a considerable portion is now under the plough, whilst the rest is sound pasture. The statistics of wheat culture are as follows :—

NUMBER OF ACRES EMPLOYED IN THE CULTIVATION OF WHEAT IN IRELAND FROM THE YEAR 1853 TO 1862 INCLUSIVE.

Years.	Acres.	Increase.	Decrease.
1853	326,896	—	—
1854	411,284	84,388	—
1855	445,775	34,491	—
1856	529,030	83,255	—
1857	562,581	33,551	—
1858	551,386	—	11,195
1859	465,497	—	85,889
1860	469,642	4,145	—
1861	406,261	—	63,381
1862	357,816	—	48,445

While the increase of the growth of potatoes indicates the unconquerable attachment of the cottier farmers to the potato as a principal article of diet, which no calamity, however severe, is sufficient to shake, the advance in the culture of wheat is the result of the decrease of small holdings, and the introduction of capitalists as the occupiers of the land, who farm on a regular system of the rotation of crops. And besides this, since the famine, the surplus of labour has disappeared, and the price of it has advanced from 200 to 300 per cent., which has enabled the peasantry to consume more wheaten bread, and less of the potato, this latter having in general become comparatively dearer than cereal food, taking into account the greater nutritive power of the latter. The price of labour is regulated by that of the most essential articles of subsistence; and whatever may be the cost of other things, whether of luxury, convenience, or even the necessity of the well-to-do classes, a low price of bread, where that constitutes the chief food of the masses, or of potatoes, rice, &c., in the countries where they respectively form the staple articles of diet, is sure to be accompanied by cheapness of labour. In India, where the labouring classes live wholly on rice, a sufficient quantity of which for the daily support of a man can be purchased for a halfpenny, labour can be procured to any extent for $1\frac{1}{2}d.$ or $2d.$ per day per man; and in Ireland, in the year 1844, previous to the appearance of the disease in the potato, that root might be purchased in the rural districts at $2d.$ per stone of 16 lbs., and the price of labour there was $4d.$ per day.*

There is a considerable difference in the quantity of nutritive matter, and, consequently, in the value of the various kinds of potatoes; and those persons who either cultivate or purchase them, without regard to quality in this respect, commit an error. The following table shows the analyses of different varieties, taken by the celebrated chemist, Payen :—

Variety.	Water.	Starch.	Fibrine and Gluten.	Totals.
Large Yellow potato	68·7	23·3	8·0	100
Scotch	69·8	22·0	8·2	100
Legonzac	71·2	20·5	8·3	100
Rohan	75·2	16·6	8·2	100
Siberian	77·8	14·0	8·2	100
Duvillars	78·3	13·6	8·1	100
Slow Island	79·4	12·3	8·3	100

* The writer knew one instance in which a hundred labourers were hired to perform some work on a gentleman's estate at $3\frac{1}{2}d.$ per day per man.

In the above, it will be seen that there is a difference of nearly eleven per cent. in the proportion of water between the first and the last, and fully eleven per cent. in that of starch; whilst the gluten varied only three per cent. If, therefore, the large yellow potato is worth £4 per ton, the Slow Island is not worth more than £2 12*s.* 7*d.*, the eleven per cent. of starch in excess in the former, and the eleven per cent. of water in excess in the latter, constituting the essential differences, the three per cent. of gluten in the Slow Island variety above the yellow being accounted for in the calculation. In the present day, when agricultural chemistry enables every farmer to ascertain these differences, it is of great importance for them to avail themselves of the means of choosing the best kind for cultivation, the difference being well understood *practically*, though probably not *scientifically*, by the dealers of Spitalfields and Covent Garden. The varieties given are chiefly French productions, but the difference in those of England are quite as great. The mode, in fact, of testing the quality, is in every one's power, being a merely mechanical process. Let a given weight of potatoes be reduced to a pulp by rasping very fine, macerate it further in water, afterwards allowing it to settle; then pour off the water when clear, and, adding fresh, repeat the process of stirring it, and so on several times; then let the residue settle, and when the water is quite clear, pour it off, and dry the matter at the bottom (which is starch), before the fire. The weight must be accurately ascertained to a grain, and it will then be easy to calculate the proportion in a larger quantity.

The above is no mere fanciful or theoretic speculation, but a really practical statement of the difference in value of different varieties of the root. It is well understood that whilst the gluten in farinaceous vegetables contributes to the support of muscle in the animal economy, starch increases the quantity of fat and flesh.* The large quantity of both these substances in wheaten flour and bread, is what makes it so valuable for food; but the predominance of gluten renders it too astringent to be eaten constantly without other food. The potato, on the contrary, from the quantity of water contained in it, is a light food, easy of digestion, and may be eaten in any quantity consistent with satiety, without any ill effects.

The spirit obtained from potatoes is equal to that of grain, if not superior. The root is used extensively on the Continent for that purpose; and in France large quantities are manufactured from it and sold for cognac brandy, at an enormous profit. Phillips, in his history of cultivated vegetables, states that Dr. Anderson obtained by distillation from one bushel (72 lbs.) of potatoes, properly fermented with yeast, an imperial English gallon of pure spirit, considerably above proof, and a quart more below proof. It was the finest and most agreeable vinous spirit the doctor ever tasted. The bushel of potatoes at that time was worth 1*s.* 6*d.*, so that, reckoning five quarts of spirit, the cost of the raw material was about 3½*d.* per quart, which corresponds with the cost of the same production in the Austrian distilleries.

When potatoes are at the price at which they could be purchased in Ireland before the famine (£1 3*s.* 4*d.* per ton), they may be profitably used in the manufacture of starch and sugar. If we estimate the starch in the tubers at the mean of eighteen per cent., one ton of them will contain rather more than 3½ cwt. of starch, which commonly sells at from

* This, however, is only the case when starch is used in combination with other substances; for starch *alone* is incapable even of sustaining animal life; and a man or any other animal fed upon *it* only, would die as quickly as of inanition or a total want of food.

£15 to £20 per ton. At the mean price of £17 10*s*., it will bring £3 0*s*. 9*d*., being an increase on the price of the raw material of £1 17*s*. 5*d*. The starch can then be converted into sugar by the addition of a weak dilution of sulphuric acid, which, instead of diminishing, adds to the weight, so that 1 cwt. of starch will produce an excess of 28 lbs. of sugar. The quality of this sugar is inferior to that from the cane or the beet-root, being what is termed a *factitious* or chemical sugar. Its saccharine power, compared with that of cane sugar, is only as 60 to 100. Of late years the potato has been much too dear to be converted into either sugar or starch in the United Kingdom, except when the disease is prevalent, and a large quantity is brought to market under the apprehension that the tubers will not keep in store. During the famine in Ireland a starch manufacturer in Dublin realised a fortune by purchasing the diseased potatoes at very reduced prices (from 10*s*. to 15*s*. per ton), and manufacturing starch from them, that of sugar being prohibited by the excise.

In Switzerland and other parts of the Continent, the potato, in its natural state, was formerly converted into bread. For that purpose the tubers were carefully dried and then ground in a corn-mill, and dressed in the same way as wheat meal, the flour being made into bread in the common method. Potatoes are used extensively by the London bakers, although the law prohibits it. On one occasion a west-end baker was summoned before the magistrate for this practice, when he truly declared that he was obliged to provide the best bread for the nobility, and he could not make it without using potatoes with wheaten flour. There is not a doubt that a proper proportion of potatoes will improve the quality of the bread, and impart a lightness and agreeable flavour that wheaten flour alone does not give to it.

The potato has been subject to several epidemic diseases, which, from time to time have attacked it with great violence. One of these, the *curl*, first appeared about a hundred years ago, and created great alarm for some years by the ravages it committed. It first appeared in Lancashire, but eventually spread over the whole kingdom, wherever the plant was cultivated. The disease showed itself in a shrinking or curling of the top leaves, just at the time when the tubers began to form, which operation was instantly arrested, and the whole plant ceased to make any progress, and frequently died. Various causes were assigned for its attacks. One, Raley, wrote a treatise on the potato, in which he says :—" Some are of opinion that the disorder, the curl, arises from the potato being cultivated too long from the tubers, without renewing them from the seed ; others, that it arises from a worm or insect which impairs the root, or the top, or both ; others, from their being planted too early or too late in the spring, or their being taken up too soon or too late in the autumn, their being manured with improper manure," &c., &c.

Raley himself adhered to the first reason, and that the potato loses its vigour after being planted from the same stock for ten years. Even Dr. Hunter, in the " Georgical Essays," states his opinion that it will not retain its fruit in perfection more than fourteen years. There may be truth in this supposition ; but it is not the whole truth, because seed-potatoes have since proved as accessible to disease as those raised from cuttings. The curl has lost its interest now, having died out, and given place to another called " the dry rot," which attacked the sets as soon as they were planted, so that they never germinated, but rotted in the ground. This disease also committed great ravages for several seasons, no satisfactory reason being assigned for its appearance ; but, like the curl, after a time, it appears to have spent itself, and left the potato free from further attacks, until in 1845 that fatal epidemic called by some the murrain, made its appearance, and has continued with more or less virulence every year since, involving in its effects the loss of millions in money, and an enormous sacrifice of human life.

The first appearance of this epidemic was at Ryde, in the Isle of Wight, from whence a paper drawn up by Dr. Salter was sent to, and inserted in the *Gardener's Chronicle* of the 16th of August, 1845. In it he describes the disease, as it has since so frequently appeared in every part of the country, and is therefore too well known to need a description. The curl and the dry rot sink into insignificance in their consequences compared with the murrain. The cause of its visitation has been the subject of much controversy amongst scientific men; and its importance was considered by government so great, that a commission was appointed to investigate its origin. At the head of this committee was Mr. R. (now Sir Robert) Kane, of Dublin, than whom no man was better qualified for the task. He was assisted in the investigation by Professors Lindley and Playfair, men equally eminent in the field of natural science with himself. But after a most laborious research it became evident that the disease was as mysterious as the two diseases that preceded it; and, in fact, the Commissioners declined giving any opinion as to its cause, except that it seemed to be connected with the cold, cloudy, ungenial weather of the season which prevailed over the north of Europe. With this idea, they hoped that a more genial season would prevent the disease in future, a hope which has not in any measure been realised, for it has appeared, with more or less virulence, every succeeding year.

Many scientific men, in their private capacity, attempted to discover the immediate cause of the disease; and the various opinions they have broached is a plain proof of its inscrutable character. Some asserted that it was a fungus, others an insect, others that it was wholly atmospheric, a fourth that electricity was the cause, &c. The Rev. Mr. Berkeley was of opinion that it was a fungus, and describes one which he detected with a microscope on the plant. But it is a question yet whether the fungus is the *cause* or *effect* of the disease; and the same may be said of the insects said to be found upon the plants. It is well known that disease, either in plants or animals, will attract both fungi and insects; but Mr. Berkeley asserts that the particular species (the *Botrytis*, we believe) that he found on the plants, do not fix themselves on decayed, but on healthy plants, and cause the disease with which they appear to be connected.

The electric theory has received many confirmations from facts that have annually occurred. With one of these the writer is acquainted from personal observation. Adjoining some land which he occupied in Ireland in 1847, was a field of early potatoes which the owner was beginning to raise about the middle of July. The tops were perfectly green and fresh, and the tubers sound; but on the 17th of July, a violent thunder-storm took place, with much vivid lightning. The very next morning the whole of the stalks of the potatoes were turned black, and the tubers began from that time to decay, until there was scarcely a sound one in the field. Another instance occurred in 1857, when a relative of the writer occupied the same land. He wrote as follows :—"I have observed for the last six years, that the appearance of the disease has been invariably preceded by a dense fog and a thunder-storm. In the present year, such a fog, followed by a tempest, occurred on the 16th of July; and I remarked to N. that it would bring the potato disease. Accordingly, the next day, on examining the potatoes, I found the tops of the stems turned black; and a hot sunny day succeeding, at night they were become quite crisp, as if they had been burned From that time the whole field rapidly declined, and in a few days the tubers exhibited all the usual symptoms of the disease. On examining them, I found them (the tubers) *covered with an aphis ;* but whether these had been one cause of the disease, or they had attacked the tubers *because* they were so diseased, it is impossible to say, but I believe the latter to be the true solution of their appearance."

Whilst, then, the disease may rationally be ascribed to electric action in some cases, its epidemic character indicates some more general cause, predisposing the plant to receive it by weakening the functions of vegetable life. This cause is, in all probability, atmospheric ; but, like that which brought the cholera by a well-defined route from the East, its nature and mode of operation have hitherto been, and will probably continue to be, shrouded in mystery beyond the power of science or observation to unravel. The cause evidently lies below or above the mere surface of ordinary atmospheric phenomena ; for the season of 1846, and several since, in which the disease has prevailed, were the very reverse of that of 1845 in respect to the weather. In proof of this, the season of 1857 was the warmest and most brilliant that had occurred for some years ; and the almost total absence of the disease the three previous years, had given hopes that it had spent itself, and was wholly disappearing ; yet, that very season, it broke out with almost as much violence as ever. It is clear, therefore, that there must be some more occult cause to produce it, than any that has yet been assigned, but which in all probability will never be discovered.

The varieties of the potato are almost endless, depending, like many other of the vegetable tribes, on soil, situation, climate, and other local circumstances. Those most cultivated in the present day are—the York Regents, a white, small, round tuber of fine quality ; the Ash-leaved Kidneys, straw coloured under the skin, and kidney-shaped ; the Ash-leaved Round, white and round. These are all of the early species, to which may be added the Common First Earlies, white and round, with small haulm. The late varieties are—the Orkney Long Reds, a bright, red skin, large oblong tubers, deep set eyes, inferior quality, but very prolific, fit for cattle feeding ; the Orkney Round Reds, buff-colour tinged with red, tubers small, round shaped, smooth skinned, fine quality, but produce small ; Cups, colour a dull pink tinged red, large size, oblong irregular shape, rough skin of medium quality, yields well, haulm a deep green, which it retains late into the autumn ; the Connaught Cups, a dull pink colour tinged with red, large size, smooth skin, oblong shape, haulm tall, upright, strong, dark green, till destroyed by frost, superior to the Common Cups, a prolific bearer ; the Jersey or Wellington Blue, large liver-coloured tuber, oblong flattened, with moderately deep eyes, good quality, very white and mealy, haulm very tall, branching and wide stemmed, a deep green colour long retained ; the Hen's Nest, a white, oblong tuber, with a deep depression at the root end, medium quality, large tubers.

The varieties most commonly cultivated in the field are the York Regents, the American Earlies, the Hen's Nest (so called from the tubers growing in a circle close to the stem), the Orkney Reds, and the Cups. London is chiefly supplied with three sorts of Regents, namely, the Yorkshire, Lincolnshire, and Scotch. The last turn black after boiling, which reduces their value to the extent of £1 per ton. This is caused by the soil in which they grow, which is of a dark, friable quality. When raised on the sound lands of the Lothians, the tubers are equal to those of Yorkshire, and fetch as good a price when sent to London in sacks, which prevents them from being mixed with others.

An inquiry was instituted by the Board of Agriculture in the year 1795, into the cultivation and consumption of potatoes in Ireland. In the report given in by the committee, it is stated that a man and his wife and four children consumed 336 lbs. of potatoes weekly, or 8 lbs. each per day; another family of the same number consumed 252 lbs. or 6 lbs. each daily; a third, 266 lbs. weekly, or 6½ lbs. daily each person; and that four grown persons consumed 48 lbs. daily, or 12 lbs. each. The allowance in the workhouses of Ireland was 16 lbs. per man daily. The present price of potatoes will not admit of so liberal a scale of dietary, and better food is now provided at a cheaper rate.

With regard to the produce of a crop of potatoes, Sir Robert Kane, in his work on the "Industrial Resources of Ireland," estimates it to average nine tons per acre; and De Jonnes states it to be from 42,000 lbs. to 52,000 lbs. per hectare, which, if we take the mean of 47,000, gives about 8½ tons. It is easy, therefore, to conceive the distress that must ensue from the absolute destruction of the produce of at least 1,500,000 acres of this root, amounting to an aggregate of 13,000,000 tons, the value of which, at only £2 per ton, would be £26,000,000 sterling, and that amongst the poorest peasantry in Europe. The alimentary matter of nine tons Sir Robert Kane estimates at 4·076 lbs. If, therefore, the crop of Ireland in 1846 occupied 1,500,000 acres, the loss in real aliment amounted to 2,729,465 tons; and those enormous losses were repeated for three years. No wonder, therefore, at the loss of human life that resulted from that dreadful visitation of Providence.

The potato is preyed upon by a great number of enemies amongst the insect tribes. The *Aphis rapæ*, the *Thrips minutissima*, the *Smynthurus solani*, or plant-bugs, the *Lygers solani contaminatus bi-punctatus* and *Umbellatarum*, pierce the leaves and imbibe the sap. The frog-fly *Eupleria solani* and *Picta*, *Altica exalcta*, caterpillars of the *Sphinx atropos*, *Agrostis sigetum*, and *Exclamationis*, or surface grubs. The crane-fly larvæ, *Tipula oleraceæ*, *Paludosa* and *Macedosa*, infest the roots. The wire-worms of *Agrostis lineatus*, *Obscurus* and *Spectator*. *Julus Londinensis terrestris pulcherris*, and *Polydismus complanatus*, *Centipedes scolopendra*, named *Lithobius fercipatus*, and *Grophilus longicormis*, &c. &c.

PART VI.—BRITISH HUSBANDRY.

SECTION I.

BRITISH HUSBANDRY—ITS DEFINITION AND PROGRESS.

WHILST agriculture embraces the whole theory of cultivation, husbandry implies the practical application of the principles of that theory, or the employment of art, in order to assist nature in the production of the fruits of the earth, whether they are intended for the support of animal life generally, or for assisting in the reproduction, multiplication, and improvement of the domestic animals required for the support of man. It is the practice of husbandry that distinguishes the civilised from the savage state; for by it man is enabled leisurely, and with forecast, to provide for his future as well as his present wants, instead of being dependent, like the beast of prey, upon the precarious produce of the chase. Even in the infancy of society, when communities of men are few and separated widely from each other, and their wants are limited to the absolute necessaries of life, husbandry is still required to raise those necessaries. The first step, therefore, in civilisation, is the cultivation of the ground; and the first real business in which man engages, next to that of a wild hunter, is that of a husbandman.

The husbandman is essentially a manufacturer. The land is his workshop or factory, the implements of husbandry his machinery, the seed and manure his raw material, and the crops he raises, or the animals he breeds and fattens, his finished goods. Of late years, the term husbandman has been merged into that of a farmer or an agriculturist so far as the occupier of the land is concerned; and is now only applied to the man who labours in the field. The term, however, implies much more than the mere drudgery of cultivation, and, in our estimation, is one of the most honourable, as it is certainly the most ancient, of titles, of which no one need be ashamed. Our great progenitor, the patriarch Noah, did not disdain to assume it, almost from the moment he emerged from the ark. Since that period the profession has always been accounted honourable, and its practice worthy of the first consideration of great and learned men in all ages of the world. If at any period or in any country it has been deemed otherwise, it is because the war principle has gained the ascendancy, and what is falsely termed national glory (which is often but another term for national madness), has been preferred to real greatness and prosperity. The present restricted application of the term is also an error, as it embraces the practice of every department of rural economy, and every individual employed in them, whatever his particular work may be, the employer himself being the chief husbandman.

It is only of late years that husbandry has attracted the attention of the educated portion of the community, or, more properly speaking, of the aristocracy of England.

The ancient landowner was satisfied with being the master of his tenantry; and, generally, would have considered it derogatory to his dignity to know anything about the cultivation of the land, or the breeding of cattle or sheep. His steward dictated the terms of the lease or yearly occupation, as the case might be; and having instructed him to enforce them with rigour, the lord pursued his pleasures, and left the tenants to prosecute their business, without further interference on his part. "Formerly," says Lord Kames, "hunting was the only business of a country gentleman. The practice of shedding blood made him rough and hard-hearted: he led the life of a dog or a savage, violently active in the field, supinely indolent at home. His train of ideas was confined to dogs, horses, hares, and foxes; not a rational idea entered the train, not a spark of patriotism, nothing done for the public, his dependants enslaved and not fed, no husbandry, no embellishment; loathsome weeds around his dwelling, disorder and dirt within! Consider the present mode of living. How delightful the change from the hunter to the farmer, from the destroyer of animals to the feeder of men! Our gentlemen who live in the country have become active and industrious. They embellish their fields, improve their lands, and give bread to thousands. Every new day promotes health and spirits, and every new day brings variety of enjoyment. They are happy at home, and they wish happiness to all."*

Such was the change that had taken place in the habits of the landed gentry towards the close of the last century, since which they have acquired a still deeper interest in rural affairs, and everything relating to the cultivation of their estates, and the advancement of husbandry. Could Lord Kames rise from the tomb and attend the meetings of our agricultural societies, he would rejoice with astonishment at the wonderful improvement since his time; by which, not only has the country been "embellished and beautified," but the produce of the soil has been doubled, and the land brought into the highest state of cultivation.

In the practice of husbandry, we are compelled, by our limited knowledge of natural philosophy, to be content with watching the effects of our operations, having but little opportunity of learning the secrets of nature as to the precise mode in which those effects are produced. Thus, we till the soil as a necessary preliminary to depositing the seed; but we cannot explain the connection between that operation and the growth of the plant, although observation and experience prove that the connection does exist. Again, we apply manure to the land because experience shows that it encourages still more the growth of plants, and increases the produce. But we are quite in the dark as to whether it acts simply as a stimulant, an attrahent, or a pabulum, or in all three capacities, which is the most probable thing; and we are equally ignorant as to the precise mode in which the plant itself receives and assimilates nourishment, whether in a dilute liquid, an aerated, or a highly pulverulent form, or in all three modes, which again, is very possible. However desirable it would be to attain to such knowledge, it is not absolutely necessary; for if by observation and experiment we ascertain that certain causes produce certain effects, we may rest satisfied with the attainments which the light of science has bestowed upon us, leaving the more occult and hidden secrets and agencies, which are probably beyond the reach of our philosophy, to be speculated upon by theorists.

The union of science with agriculture has raised the character of the latter, without

* "The Gentleman Farmer," p. 20, preface.

derogating from the dignity of the former. It has transformed husbandry from a merely imitative art, in which little or no improvement had ever been tolerated or even possible, to an intellectual and progressive one, in which the spirit of inquiry and of experimental and practical investigation has succeeded to blind and unreasoning routine. Still the nature of husbandry is not changed, however it may be improved and modified; and the transformation it has undergone is in the *man*, not in the *thing*, the changes that have taken place being merely the development of the eternal principles on which nature acts in the production of the fruits of the earth.

The increased attention paid to British husbandry of late years has arisen from several causes. First, our insular situation, which would otherwise render us dependent at certain seasons on other countries for food; secondly, the limited extent of land with a numerous population, which imparts to the land a greater value; thirdly, the inferior quality of the soil which renders necessary greater efforts to make it productive. We have seen that it was not until the end of the last century that these causes began to operate, because the previous extent of the population and its stationary character did not require it. But its rapid increase which accompanied the growth of our manufactures, and especially the consequences of the protracted war, in which the country was involved, which raised the price of every kind of provisions, while it prevented us from obtaining supplies from abroad, directed the public attention to the state of the land, and the means of rendering it more productive. Many obstacles still present themselves to prevent the improvement being carried still further, such as absurd and injurious covenants, yearly tenancies, the game laws, the want of a tenant right, and above all, the law of entail. While these evils exist, it is plain that the state of the land of England, as between the owner and the occupier, is far from what it ought to be to enable the latter with safety to improve it to the extent he would otherwise do.

Notwithstanding these drawbacks, an immense increase of capital has been invested in the cultivation of the land, and men of intelligence and science have embarked in it. Some of these have expended large sums in experimental husbandry; and, although many of these speculations have been unsuccessful, and their failure has for a time checked the spirit of enterprise, they are far from having been lost. If an agricultural speculator introduces, at a great expense, an innovation in husbandry, it is the business of his contemporaries, not to condemn his proceedings, but to watch their effect. If success attends it they will adopt it, if it fails they will avoid it. In either case the man is a benefactor to society, and deserves respect and esteem, instead of censure and ridicule. In this respect, Alderman Mechi, whose name we scruple not to mention, because he has made himself public property, is one of the greatest benefactors the farmers ever had among themselves, because he freely communicates his proceedings and their results amongst his brother farmers, and because he has not hesitated to expend large sums in experiments, the advantage of which to practical men is incalculable, if they think proper to avail themselves of it. Little, indeed, does he deserve the determined hostility and opprobrium which has so unscrupulously and unjustly been heaped upon him, and is only equalled by the equanimity and good-humour with which he parries the blows aimed at his reputation.

The business of the husbandman is of a very mixed character, requiring a more varied knowledge, and practical observation, than perhaps any other industrial pursuit. The cultivation of vegetables is the easiest and most commonplace portion of his engagements, certainly that which requires the smallest degree of attention and solicitude. The preparation of the land, the depositing of the seed, and the succeeding operations, follow each other with as much regularity as the months in the year. It is the breeding, rearing, and management of the domestic animals of the farm, that demand his most constant and unwearied attention, whether they are those required for human food, or those which contribute to the labour of the farm or the luxury and convenience of the husbandman. For the support of these, and for the promotion of their comfort and well-doing, large provision must be made, and a regular establishment kept up, distinct from that required for the production of grain. The foresight, vigilance, and judgment necessary to be exercised in the maintenance of animals, is the consequence of their utter helplessness in the domesticated state to provide for their own wants, or to save themselves from, or to cure, accidents and diseases. With a material organisation similar to that of man, but without his intelligence, they are wholly dependent upon the exercise of his mind and his constant care for their preservation. Day and night, from the beginning to the end of the year, must this care and vigilance be exercised; and the more tenderness and consideration this is accompanied with, the greater will be the advantage to the owner.

Still the business of the husbandman in raising vegetable produce requires a vast amount of practical knowledge, foresight, and activity. Every man who assumes the profession ought to make himself acquainted with the nature and properties of the plants he cultivates, and to be able to select those best adapted to the soil for which they are intended. Half the failures may be ascribed to ignorance of, or inattention to, these and similar matters, or of the best method of cultivating the plants. We could not adduce a stronger case than that of Mr. Hallett, of Brighton, and his neighbours. The one consults the nature of the wheat plant, and sows 1 peck per acre, and reaps *at least* from 5 to 6 quarters. His neighbours sow from 3 to 5 bushels per acre, and reap *at most* 4 quarters. They follow the traditionary practice of their forefathers, he avails himself of the light of science; and by experiment discovers the capabilities and requirements of the plants he cultivates, and acts accordingly. His success is the best practical commentary upon his system; they plead the "wisdom of their ancestors," and throw away from 11 to 19 pecks of seed per acre, and one-third of the produce.

Until within a comparatively recent period of our history, the land of England was cultivated on the triennial system—viz., two grain crops and a bare fallow. Even after the introduction of green and root crops, clover, turnips, &c., that system was adhered to by the husbandman over a great part of the kingdom, as it is in France to the present time, and for the same reason, because a large proportion of the land being open common fields, it was not possible to farm on any other principle. The uses ascribed to the bare fallow, were the perfect pulverisation of the soil, the destruction of weeds, and the general amelioration of the land. Before the introduction of root and green crops and the system of rotation, this mode of husbandry was the only possible way of restoring fertility to the soil, or of preparing it for the production of corn crops. And it is obvious that it had this effect, because the land had for ages been under cultivation, and crops of grain taken from it, whilst very little was otherwise done to make amends for the exhaustion the soil had suffered. Yet the land exhibited no symptoms of declining fertility, thereby proving that the bare fallow, with what little manure was produced from the hay and straw, were sufficient to prevent it from deterioration. Tull, and many imitators of his system, have demonstrated the truth of this theory, that by opening the soil to the action and influence of the atmosphere, alone, its fertility may be sustained.

What, however, the bare triennial fallow effected, is much more beneficially and profitably done by the cultivation of root and green crops. The former, especially, opens and pulverises the soil, the hoe extirpates the weeds, and the increased quantity of manure ameliorates and enriches the land in a much greater degree than the bare fallow; whilst instead of two small grain crops in three years, and at the full expense of three crops, except the seed, the husbandman has now a profitable crop every year, by which the production of food has been doubled, and the land, where properly managed, always maintained in the best state of cultivation, which term itself has now a greatly extended signification. The plough, or spade, and the harrow, are not the beginning and the end of cultivation; a variety of subsequent and intermediate operations upon the surface or the subsoil are performed, employing other implements than the primitive ones, and undreamt of in former days; and these have been multiplied and improved, to the increase of the range, and at the same time lightening of the labour, of husbandry.

SECTION II.

OF THE DIFFERENT KINDS OF FARMS.

The man who proposes to adopt the profession of a husbandman, or farmer, is not confined in his choice to one department of the business, there being several different kinds of farms, varying in the nature of the occupation and in the knowledge they require. Farms are divided into two kinds—Pastoral and Arable, or Cultivable. The pastoral farms again consist—First, of extensive tracts of mountain or down land, on which large herds of cattle or large flocks of sheep are bred and pastured, chiefly for supplying the occupiers of arable farms with animals for fattening. The quantity of land cultivated on these pastoral farms is generally limited to what is required to supply the labourers of the establishment with food, and for raising green or root crops for the animals during winter. Secondly, dairy farms, comprising rich meadows and upland pastures for the maintenance of milch cows, for the purpose of manufacturing butter and cheese, the arable portion of such farms being cultivated chiefly for supplying the cattle with winter food; and in some cases even this is purchased of neighbouring farmers. In the vicinity of large cities or towns, extensive dairies are kept, to supply the inhabitants with milk; and the owners of these usually occupy grass farms, for the cows in summer, and for hay, and purchase roots in winter.

Arable farms are also of two kinds; those that are devoted to the cultivation of cereal produce, alternating with green and root crops—these latter, for the purpose of supporting the domestic animals kept on the farm, whether for labour or for raising manure, in connection with fattening for the butcher. Formerly, the arable land, as we have stated, was chiefly farmed on a triennial course, every third year the land lying fallow; but the bare fallow has now given way to a more profitable course of husbandry, by which the land is continually under crop of some kind, and thrice the number of animals can be kept. By this means a large quantity of manure is raised. The stock on the arable farms are, for the most part, purchased at the various fairs and markets, generally after harvest, and, being fattened during the winter, are sold as the summer approaches. Very few breeding cattle or ewes are kept on such farms.

Another kind of arable farm are those the occupiers of which are called "market gardeners." These farms are chiefly, and in some cases wholly, employed in raising fruits and vegetables, for the supplying of large cities and towns with all kinds of table and culinary produce. On these farms, which seldom exceed three hundred acres in extent, no stock, generally speaking, is kept except those required for labouring the land, and a number of pigs, to consume the refuse produce of the fields. These market gardens are kept in a high state of cultivation, and the produce is enormous. In some cases the spade only is used, and the soil stirred to a great depth. We shall treat of these different kinds of farms separately, in the order in which we have placed them.

SECTION III.

THE PASTORAL FARMS.

First, the Mountain or Down Farms are the most simple in their management, and inexpensive in the outlay required for labour, of any description of land. It requires, it is true, a considerable capital to stock them in the first instance; but the staff to work it is small compared with that of the arable farms. It consists of a shepherd or cattle herd to a certain number of sheep or cattle, a steward or bailiff to overlook them, and a sufficient number of men and horses to cultivate the small proportion of arable land requisite for the support of the establishment, and to raise roots and hay for the cattle during the winter. As few or no animals are usually fattened on the mountain farms, they are annually sold to southern dealers on arriving at a certain age, and thus replace a portion of the capital expended in the first instance in stocking the farm.

Perhaps we could not give a more clear idea of a farm of this description than by relating the manner in which the Sutherland estate, in the North Highlands of Scotland was converted into stock farms at the beginning of the present century. The Sutherland estate consisted of 800,000 acres, and was held by tacksmen, or leaseholders, in large districts, and sub-let by them to cottier tenants, at comparatively high rents. The state of permanent misery and poverty in which these latter existed, and the unprofitableness of the country, either in the support of the inhabitants or remuneration to the proprietor, led the Countess of Sutherland, upon her marriage with the Marquis of Stafford, to propose to her husband the removal of the people to the more fertile lands on the coast, and the conversion of the mountain districts into sheep-walks.

This measure was commenced about the year 1811; and the land being cleared of its former occupants, the swamps and bogs which existed on the sides of the mountains were drained, and every necessary operation performed to free the surface from the stagnant water with which, previously, it was constantly saturated. This being effected, those spots which would not bear a dog in their original state, were soon covered with a close herbage, firm enough for sheep to feed with safety. In addition to this, the heather, which formerly clothed the drier part of the mountains, was burned, and made room for the natural grasses to spring up; thousands of acres of this natural pasturage have thus been created, and have increased the productive powers of the soil to the extent of one-third.

The stock of sheep now kept on these mountain pastoral farms is very large, but we have no means of stating the number. Some years back, they amounted to upwards of 130,000, and the export of wool was about 420,000 lbs. The sheep were mostly of the Cheviot breed, which were found to be the best adapted to the soil and climate. They are sold at two and three years old, in flocks of from 300 to 500 sheep each, to southern dealers, who drive them to the Yorkshire or Northumberland fairs, where they are sold to the farmers and graziers for fattening. The extent of some these sheep farms is very great. Two were let in 1819 to two Northumberland gentlemen, which comprised together near 100,000 acres, more than one-third of which they converted into good pasturage. Other sheep farms on the estate contain from 10,000 to 20,000 acres, and are rendered equally profitable to the occupiers, who in the first instance paid a rent of one shilling per acre.

The Cheviot Hills, in Northumberland, formerly known as *Chevy Chace*, and as such celebrated for the battle between the earls Percy and Douglas (the foundation of the old ballad of "the Hunting in Chevy Chace"), are also famous for their breed of sheep, so admirably adapted to hilly countries. The hills of Cumberland, and most of the Welsh districts, are divided into pastoral farms, the latter being chiefly appropriated, like the North Highlands and the Western Isles of Scotland, to the breeding and rearing of cattle. The North Highlanders are small, black, and horned; those of the Western Islands, called Kyloes, are larger, and possess finer symmetry. The higher parts of these countries are, like Sutherland, sheep farms. The stock chiefly kept on them are the black-faced mountain breed. The hills more south are stocked with the Cheviots, which are hornless and white-faced.

In winter the sheep receive very little aid for their support. A little hay, saved on the slopes of the mountain foot, is given to them, but they live chiefly on the heather and what grass they can pick up. A few turnips are cultivated, but they are very sparingly given to them. The losses the farmers sustain sometimes, when the winter is severe, are very great, both in cattle and sheep, especially if the lambing time is unfavourable. The stock farms in the Highlands range from 1,500 to 3,000 acres, the proportion of arable land being very small, and lying chiefly on the banks of streams at the bases of the mountains, where they are enclosed. The rent is regulated according to the number of cattle or sheep the land will carry. Formerly, all the sheep and cattle on the Scottish stock farms were sold to southern graziers; but since the establishment of railways between the two countries, many of the stock farmers fatten a portion of them, and send them to the large Scottish or English cities and towns; sometimes even so far as London, when the price of meat is remunerative.

The knowledge required by the pastoral farmer is chiefly limited to a thorough acquaintance with everything relating to stock, whether cattle or sheep; and, even with the best of servants, the master's eye must be constantly on the watch over them to see that nothing is neglected, and to detect the first symptoms of disease, if they occur. They say that "it is the eye of the master that fattens the beast." We once knew an old traveller who always made a point of *combing his horse's tail* all the time he was eating his feed of oats, in the stables of the inns he stopped at, and when asked the reason, he said he "found the oats did the animal so much more good;" and no doubt they did so, when the ostler had no opportunity of cheating him of half his ration.

Secondly, the Dairy Farm. This description of pastoral farm consists of extensive meadows and upland pastures of natural grass, kept in a high state of fertility, and devoted to the feeding of milch cows for the purpose of manufacturing butter and cheese. Sometimes sufficient arable land is kept under the plough, to supply the cattle in winter with green or root food; and a large portion of the pasture land is also saved for hay, for the same purpose of winter feeding. In Cheshire, the usual proportion of arable land in the pastoral farms is about one-fourth. The stocking of a dairy farm is expensive if the best cows are purchased. We have known a dairy farmer who gave as high as from £50 to £100 for some of his cows, which were of the Short-horned breed. Unfortunately, the pleuro-pneumonia broke out amongst them, and every one of the most valuable cattle died.

It is a common practice now to keep the cows in stables or "byres," as they are termed in Scotland, in summer as well as in winter. In the former season, they are fed with cut grass, tares, lucerne, &c., and in winter with the usual roots, and plants, and hay. The rearing of stock is no part of the business of a dairy farmer, except the cow-calves necessary to supply the places of such of the stock as are thrown out on account of age, or unprofitableness, or other causes. The bull-calves are invariably fattened for the butcher.

The dairy farms seldom exceed 300 or 400 acres of pasture land. In England, Cheshire, Derbyshire, and Gloucestershire are the principal districts; but a great number of milch cattle is kept in Suffolk; and throughout the kingdom, in the neighbourhood of large streams, where the meadows are luxuriant, large dairies are kept, especially in the vicinity of cities and towns, where there is a constant demand for dairy produce. In and round London vast dairies are kept; that of Mr. Rhodes, at Islington, is said to contain 1,000 cows. These are all kept under cover, except it be for a few weeks during the summer months, or to restore to health those which are attacked with disease.

In Norfolk, and other counties, there are extensive tracts of grazing land, consisting of old pasture, which are let out in summer to farmers who have not enough of grass-land on their farms to support the cattle at that season. These lands are of two descriptions: those which consist of rich meadows on the borders of rivers, by which they are occasionally overflowed, and thence require no dressing with manure. Such lands will sustain a large number of cattle throughout the summer. The other kind are upland old pastures, generally studded with old oak trees, reserved for shade and shelter to the cattle. A herdsman living on the spot is deputed and paid by the owner of the land to overlook the "gist" cattle belonging to the distant farmers. These lands, of course, are stocked only with store cattle, intended for fattening the ensuing winter; but in some cases, if the grounds are not over-stocked, they get very forward, so as to be ready for the butcher at an early period, if they are not kept too late in the pasture.

But besides these, there are what are called "salt-marshes," which consist of extensive tracts on the banks of rivers up which the tidal waters flow, and occasionally overflow their banks; or of lands from which the sea has receded. Many of these tracts possess great fertility, and large numbers of cattle and horses are kept on them during the summer.

In pastoral farms the best of the feed should be appropriated to the largest of the fatting cattle. These should in all cases be allowed to take the first run of all the feeding-grounds, if it can conveniently be spared for them, but certainly that of the richest; and the inferior pastures to the smaller breeds, such as the Devons, the Welsh, and the Scotch Highlanders. These two latter, accustomed to hard fare on their own bleak mountains, will thrive well upon the second or third rate pastures of England, and will clear everything off by the end of July, when the fields may be shut up, and left to produce a second growth for autumnal feeding for another lot of fattening cattle.

Sheep-grazing is a different branch of the subject; and in England, extensive tracts of country, considered too poor for cultivation, are appropriated to this species of stock. The South Downs, in Sussex, and those of the adjoining counties of Hampshire and Oxfordshire, and the Cotswold Hills of Gloucestershire, to which we may add the sandy tracts from Newmarket to Thetford and Brandon, in Norfolk, are all covered with large flocks of sheep, and form the breeding-grounds, from whence immense numbers of lambs are sent to the different autumnal fairs, to supply the sheep-graziers with winter stock to consume their root crops.

All grazing lands should be fed down close before winter, otherwise the tufts of coarse herbage left will materially injure the quality and the growth of the grass the ensuing summer. If the stock will not eat it down, it should be cut close with the scythe; after which, when it becomes withered, they will eat it readily. Weeds should be carefully extirpated, either by frequent cutting down or by digging them up, the latter being the best plan. Fences should be kept in constant repair, nothing being more troublesome to the farmer than breaches in the hedges, or more injurious to fattening or growing cattle than the power of straying through gaps in a fence from their own pasture. If they are once able to break bounds, it unsettles them for weeks, and they will almost constantly be found hankering near the gap, especially if a corn or clover field is beyond it.

SECTION IV.

ARABLE FARMS.

First, the term embraces all those farms, the principal object of which is to raise cereal produce, by practising a regular course of husbandry. The quantity of pasture land on these farms is generally very small, and only sufficient for the support of the working animals necessary to cultivate the ground, and a few cows to supply the family of the farmer with dairy produce. Many such farms in Norfolk Lincolnshire, Yorksh re, &c.,

consisting of from 500 to 2,000 acres of land, do not contain 100 acres of old pasture-land, the whole being laid out in large fields, conveniently arranged for growing the succession of crops, according to the course determined on by the occupier. In some cases, however, a mixed husbandry is practised where the farms lie on the banks of a river, in which case the lands immediately adjoining the stream are meadows, while those in the uplands are under tillage.

This mixed husbandry is, on the whole, the most profitable, as it offers a greater variety of produce, some of which will succeed when the other fails. Thus, a wet season, that will be injurious to corn, will suit the grass, whether for feeding or for hay, provided the latter can be saved in good or fair condition. It also enables the farmer to maintain more stock, and thus to raise a larger quantity of manure for his arable land; although the pasture land itself will require to be dressed with manure of some kind. The facility, however, of obtaining condensed artificial manure is now so great that whatever deficiency may be felt, can be supplied at a moderate cost, without adding materially to the labour of the farm.

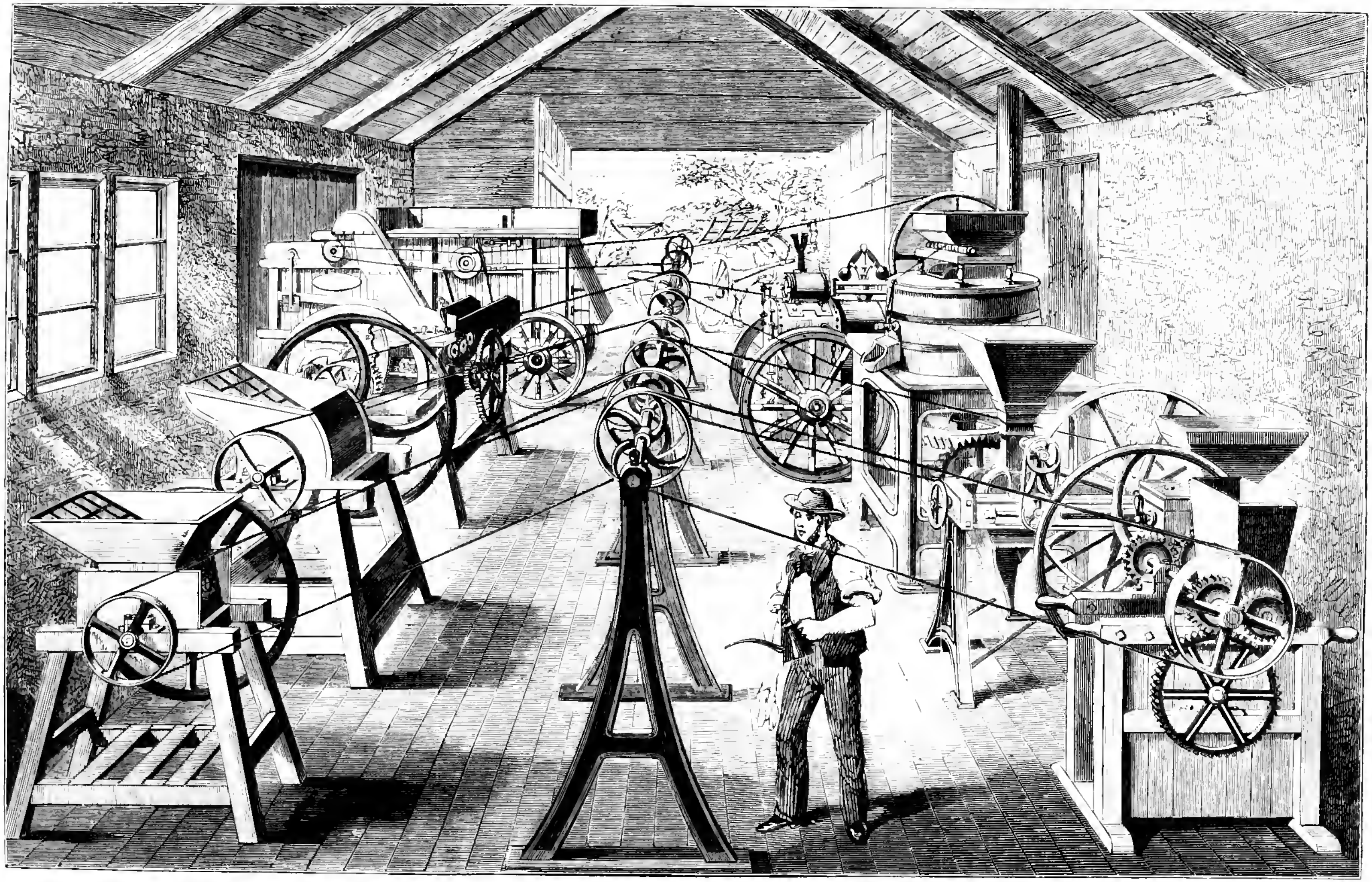
The division of arable farms into heavy and light soils renders necessary a very different system of husbandry, which will be treated of in the proper place. A good mixed soil, where it can be obtained, is the best to cultivate; whilst a light one offers the greatest opportunity for improvement, at the same time that it usually bears a lower rent than any other description of land. A large proportion of the arable land of England is of this kind of soil, and it is wonderful how productive some light-land farms have been rendered by judicious management and deep tillage. They are more liable to weeds than heavy soils, but these do not always indicate poverty of staple. It is related of a blind farmer that he went over a farm for the purpose of purchasing it, and requested to be taken first to the fallows. Having reached a field under fallow, he dismounted, and said to a farm labourer who accompanied him, "Just tie my horse to a stout thistle." "Sir," replied the man, "there is not a thistle in the field, but there are some strong docks." "Very well," rejoined the blind man, "then I decline the purchase, and wish you all a good day." The fact is, thistles, though difficult to eradicate, generally speak a good soil, whilst docks are still more stubborn tenants, and are as indicative of the poverty of the soil.

Secondly. The Market-Garden Farms are purely arable, and are wholly devoted to raising roots, vegetables, and fruits for the table. These seldom exceed 300 acres in extent, but they are highly cultivated, and require a large outlay of capital to stock and carry them through the season. They generally employ a great number of hands, use enormous quantities of manure, and spare no pains in rendering the land productive by watering in dry weather, and keeping the spade and hoe constantly at work, producing sometimes three crops on the same land in the year, at an outlay of £30 or £40 per acre per annum. A good market-garden, in the neighbourhood of London, will sell for £200 per acre.

Occasionally, a crop of grain is taken on the garden land, by way of change; but, generally, the soil is too rich to grow wheat to advantage. The straw, however, is required, and when not grown on the land, must be purchased. Working horses also require hay, straw, and corn, and these it answers the purpose of the gardener to purchase rather than to cultivate. He must, however, keep cattle or pigs to consume the offal and what other produce cannot be sold. The knowledge of general husbandry is requisite for this kind of farming, and in addition, of the rearing and treatment of all kinds of garden produce, and an acquaintance with the markets, and the seasons when certain fruits and vegetables are most in request, it being in a great measure dependent upon a strict attention to times and seasons in this respect that the profits of a market-garden depend. These, however, upon a well-cultivated soil are generally very large, although occasional failures of crops take place, especially in that principal one, the potato, which, since the year 1846, has been a very precarious dependence.

Market-gardeners purchase their manure in the towns at which they dispose of their produce. The quantity they apply to the land is very great, sometimes as much as 40 tons per acre. The spade is most commonly the implement used in tillage, although some gardeners use the plough. They say that "one acre cultivated by the spade, is more profitable than five acres with the plough." The produce of the latter is always inferior, and is usually sold to the hucksters at a very low price. In many of the gardens around London the land is kept in beautiful order. Not a weed is to be seen; the surface is as level as a bowling-green; the whole, with the exception of the paths, is always under crop. Most of the large ones have extensive orchards of apple, pear, plum, and cherry trees, which are kept regularly pruned. Between the trees, which are all in rows, are plantations of currant, gooseberry, and raspberry bushes, and rhubarb amongst these. When the rhubarb is off, cabbages are planted; and thus, throughout the whole garden, no sooner is one crop taken off than the ground is dug or forked over, and replanted with cabbage, lettuce, cauliflower, broccoli, &c., as the season requires. Large numbers of bell glasses are employed for raising early vegetables, such as cauliflowers, rhubarb, &c. In one garden of 150 acres, at Fulham, there are 4,000 hand-glasses and 1,000 frame-lights, the latter for raising cucumbers, melons, and other delicate fruits or plants. The number of persons employed is one hundred and fifty in summer, and seventy in winter, the men being paid 2*s.*, and the women from 1*s.* to 1*s.* 6*d.* per day. On such a garden, twelve horses are kept, for the purpose of taking the produce to market and fetching home manure. The capital employed in such gardens must necessarily be very large, but the returns are fully as great, and we have heard of a produce of £250 per acre in the year being realised in some instances. These establishments can only answer in the vicinity of large cities and towns; but since the extension of the railway system, many farmers in Lincolnshire, and other distant parts of the country, cultivate both fruit and vegetables for the London market. These are sent up by the luggage trains at a small expense, and the prices generally secured fully remunerate the growers.

The more extensive of the market-gardeners devote a large portion of their land to the cultivation of potatoes, and many thousands of acres of this root are grown near London. The early potatoes are raised with artificial heat, under temporary coverings, which we shall describe when treating of the general process of growing them. It has been a precarious crop since the disease appeared in 1846, but the growers are not at all dismayed at a slight visitation of the epidemic, since it enables them to obtain a high price for the sound roots. Potatoes and cabbages form the staple articles of produce of some of the market-gardeners' farms, which are comparatively of modern growth, especially in the present extent and mode of conducting them. The regularity with which the three millions of the population of the metropolis are supplied with vegetables and fruit, the constant abundance and cheapness of these necessaries of life, and the absence of waste



AGRICULTURAL MACHINERY.

in the disposal of it, is one of the marvels of London, when it is considered that the whole depends upon the spontaneous efforts of the producers, who are entirely free from all official pressure or interference. Nothing contributes more to the healthfulness of the people, shut up, as many thousands of them are, in close rooms and warehouses, than this regular and abundant supply of vegetable food, so necessary to preserve the blood in a pure state, and prevent the access of disease.

SECTION V.

IMPLEMENTS OF HUSBANDRY.—THE PLOUGH.

NEXT to the spade, which is not used in this country on the common arable farm, the plough is the most ancient implement of tillage, and its invention is lost in the lapse and darkness of past ages. It is probable that the employment of oxen as beasts of draught, and the invention of the plough, were simultaneous—the latter rendering the use of the former necessary. All other operations in husbandry could be performed independent of animal power, while the spade was the only instrument used for turning over the soil.* But whatever people were the inventors of the plough, and its necessary accompaniment, the employment of animal power, it has descended in its use throughout all subsequent ages, and in all civilised countries—once rude, it is true, in its construction, but efficient in its primary object—the relief of man from the laborious work of tilling the soil by hand.

The plough is frequently mentioned in Scripture, and can also be traced back to a very distant period in the Greek and Roman writers. There are many engravings on seals, medallions, and other ancient works of art, of the ploughs used in both Egypt, Rome, and Greece, all of which are of the simplest and rudest description. An angular share, of hard wood, probably tipped with iron, and fixed into a bar of wood, two upright handles, morticed to the same, to which also the ropes or traces were fastened, the whole drawn by two oxen—the ploughman holding by the handles, and directing the animals with a staff or pole. Whether the Romans first introduced the plough into Britain is not certain; but there is no doubt that they brought their own model of the implement with them, and that it continued in use here for many centuries. A still more simple form of the plough was used by the Saxons, being shaped exactly like an anchor, one of the flukes of which stirred the soil, while the other was held by the ploughman. This also was drawn by a pair of oxen, but could only stir, without turning over, the soil.

* When the Island of Madagascar was first discovered by Europeans, the land was regularly cultivated and cropped with rice, barley, and other produce. But although there were abundance of oxen, both wild and domesticated, the natives neither appropriated them as beasts of burthen or of draught, nor had they even a spade, the soil being stirred with a stick hardened in the fire, the seed put in by hand, and the produce carried home on the heads of women. A horse had never been seen on the island; and when the French officers first appeared on horseback, the natives believed that the man and horse were one animal, and fled from them in terror.

We know but little of the modes of husbandry of the early and middle ages of British history. The chief records that have come down to us relate more to the destruction of human life by war than to its preservation by the culture of the arts of peace. In the absence of books, and with very restricted social intercourse between different parts of the country, it is no cause for surprise or blame that progress and improvement in husbandry was slow, and that the implements employed in it were rude in construction. The plough, from its make, was probably laborious to the cattle that drew it, especially when it was fastened to the animals' tails, as was formerly the case in England; and, certainly, in Ireland so lately as the seventeenth century, when an act of parliament was passed to prohibit the practice in future.

It was, therefore, only at a comparatively recent period that attention has been paid to the construction of the plough by the application of mechanical principles, thereby to increase its efficiency and reduce the labour of the cattle employed in drawing it. The heavy, cumbrous implement, to draw which alone was hard work for two horses, was in universal use. In Scotland, where oxen were chiefly employed, as many as ten were sometimes attached to one plough, and never less than six or eight. This continued up to the time of the American war, when Lord Kames wrote his celebrated work, exposing the defects of Scottish husbandry, and recommending the English practice. It is remarkable, as is stated by Sir John Sinclair, that within forty years, the Scottish farmers had not only adopted the practice of England, but had improved upon it, the results of which are seen in the high state of cultivation to which the land has been brought, and the large rents that are sustained for it.

It is evident that, in the construction of a plough, regard must be had to the nature of the soil for which it is intended. Local habits also have considerable influence in the matter, and must of necessity be, in some measure, yielded to. For instance, it would be difficult to persuade a Norfolk ploughman, accustomed as he is to the wheel-plough of his native county, to relinquish it for a foot-plough. Nor would the Kentish ploughman exchange his turn-wrest plough for the best Howard's or Ransome's that ever were constructed. There is, however, in all the varieties of the plough, a necessity for the maintenance of the same mechanical principles in their construction. And if any of those of local make have not yielded to improvement, it is probably not because they are so contrary to all acknowledged merit as to be incapable of it.

In Scotland, where the land in many parts is a good deal sprinkled with boulder stones, the plough employed is necessarily heavier and stronger than is required on the light or mixed-soil lands of England. The clays, too, of Essex and Kent would greatly try the strength of the ploughs used upon the light sands and gravels of Norfolk. Yet, in all, the operation to be performed is the same in principle, and requires that the same regard should be paid to the construction of its parts, so that it may perform the greatest amount of work, in a given time, at the least expenditure of animal power.

In forming an opinion of the perfect efficiency of a plough as a cultivating implement, it is necessary to consider what is the object of tillage; and this may be defined to be the best and speediest pulverisation of the soil, in order to convert it into a seed-bed. Is then the common plough, even of the most modern and improved construction and form, the best calculated for that purpose? This is a question we have not yet seen put in a tangible and practical form, but which appears to us to be the most important relating to tillage. Let us therefore examine the operation of a plough of the most recently improved construction, and such as has obtained the sanction and approbation of the judges at our agricultural shows.

The object the manufacturers of these ploughs (of whom there are many) have had in view, is to produce an implement that will turn the cleanest furrow at the least expense of animal power. For this end their ingenuity has been exercised to find out the proper angle at which the share and the mould-board should be fixed—the one to cleave the soil, the other to turn it over in the most perfect and unbroken manner, so as to exhibit a smooth and mathematically exact furrow-slice. To ascertain the amount of resistance the various ploughs had to overcome in performing this work, the dynamometer has been employed, and the judges have awarded the prizes at the competitive trials according to the results given by that instrument. The late Mr. Pusey stated the objects to be attained by these experiments as follows:—1st. To find the absolute resistance to the motion of any particular implement when at work *in different soils*. 2nd. The relative draught of the various forms of the implement in the performance of the same work. 3rd. The relative resistance to the motion of the plough, made by the different sources of its draught, viz., its weight, the action of the share and coulter in cutting the sod, and that of the mould-board in turning it. 4th. The absolute influence of the weight of the plough upon its draught. 5th. The influence of velocity on draught in ploughing. 6th. That of inclination on the surface of the ground. 7th. The influence of the depth of ploughing on the force required. 8th. The influence on the draught of a plough, of one or more wheels, as supports for its beam."

There is not a doubt but that all these questions have been satisfactorily solved, and that the construction of the most modern ploughs has been carried out on strictly scientific principles, so as to reduce the requirement of power to the minimum, whilst the work of tillage is executed in the neatest manner. But another question arises, whether, in effecting these objects, the machinists, as well as the judges, have not wholly lost sight of another and more important one, namely, *the most expeditious and effectual comminution of the soil, and its conversion into a seed-bed.* We can best explain our meaning by a practical illustration.

At the meeting of the Royal Agricultural Society at Warwick, the competitive trial of the ploughs was made in a field, the soil of which was a stiff clay, baked hard by the summer sun. Each of the ploughs was drawn by a pair of horses, and it was with difficulty that any of them could draw the implement through the stubborn clay, which was lifted up in huge lumps, instead of a continuous furrow-slice; and a farmer remarked to the writer that "it would take a long time to reduce it into a seed-bed." And so it would, for even the best clod-crusher produced little or no effect upon it.

On the other side of the hedge of this field was another plough at work on an equally stubborn piece of clover lea. This implement had been ignored by the judges, who, for some unexplained cause, had ordered it out of the trial field. Its construction was altogether different from any of the others, having *three shares;* the first of which took off two inches of the upper soil, which it turned over to the bottom of the preceding furrow. The second share took three inches more, turning it over the first; and the third share also took three or four inches, which completed the furrow. What was the result of this division of the furrow-slice into three parts? That instead of the soil breaking up in large lumps or in one smooth, continuous furrow-slice, the entire eight or nine inches was completely pulverised; and, as the occupier of the land remarked, "was fit for a seed-bed without putting a harrow on it."* Another advantage attached to this plough is the perfect manner in which the surface is buried in the furrow. Being cut off by the share just below the crown of the sod, it is turned over in a loose state to the bottom of the preceding furrow, and from five to seven inches of the soil thrown over it by the two following shares, so that not a particle of it appears above ground; whilst with the common plough a ridge of vegetation rises at the edge of each furrow-slice, very troublesome to the hoers. Now, if the object of ploughing is to prepare the land in the quickest and best manner for the reception of the seed, this implement must be superior to any of the others, for assuredly it executed the work in the most efficient and useful manner.

What, again, is the effect of turning the furrow-slice over in one smooth continuous ridge? For dibbling it may be very well, because the dibbling iron does not penetrate through the sod. Nevertheless, the regularity with which the furrow-slice is laid causes a *triangular hollow* next the subsoil that is very injurious to the young plant, as every farmer knows; for when the roots penetrate through the sod, and reach the vacant space, its progress is stayed for the time, and its constitution weakened. The same is the case if the seed be drilled, and perhaps to a more serious extent. The hollow also harbours insects, which attack the roots of the plant and frequently destroy it, without the real cause being known. Thus, the very perfection of the operation of turning over the furrow-slice "in the cleanest and most unbroken manner," is, in point of fact, the most serious defect in the work of the modern ploughs; because if the land is intended for immediate sowing upon the turned up flag, it does not leave the soil in the proper state for it; and if for a future sowing, it protracts the process, rendering a succession of other processes necessary, which might be spared if the most direct method for pulverising the soil were adopted.

The object of the machinists in the construction of the modern ploughs appears to be, to lay the furrow-slice over the foregoing one at an angle of forty-five degrees. "It is believed," says Mr. Morton, "that the value of the operation of ploughing, lies in the exposure of a fresh surface, and in raising the earth *in the form of ribs*, which, when pulled down by the harrows, forms a seed-bed. That land is thus best ploughed which has the greatest surface exposed, and which has the greatest quantity of earth raised in the form of these ribs." This is the common idea of perfection in ploughing, and while it is quite correct in theory, it is altogether wrong in the mode of effecting the design.

Mr. Smith, the inventor of the "smashing-up" style of steam cultivation, has thrown much light on this subject, by asserting the principle that the main object of tillage, whether by the common plough or any other implement, is not to produce a handsome surface and a smoothly turned furrow-slice, but a deeply stirred and well pulverised seed-bed as efficiently and speedily as possible. This opinion is fast gaining

* We have stated this case exactly as it occurred. The plough in question was the invention of Messrs. Hancock, now of the Iron Works, Tipton, Staffordshire, who, after years of struggling against prejudice and powerful opposition, have succeeded in establishing their plough in the estimation and patronage of the agriculturists.

The writer ought to state that it was from witnessing the effect of Hancock's plough on this occasion that his eyes were opened to the true nature of the operation; and so convinced was he of the injustice of the judges in ignoring that implement, that he wrote a strong recommendation of it on the spot, which was inserted in the *Warwick Advertiser* the same day, being the first notice the plough had received in any public journal.

ground amongst the farmers, and must very soon be the principal aim of the inventors of cultivating implements and machines, whether worked by animal power or by steam. One of the most influential of these firms (Messrs. Howard and Co., of Bedford) has already, to a certain extent, adopted the principle we have laid down; and in a paper we have received from them, have expressed themselves as follows:—

"Very considerable progress has been made during the last two years, not only on the mechanical appliances for steam culture, but also in the development of steam as a motive power for cultivating the soil. A great revolution has also taken place, during the same time, in the ideas of farmers upon the question of the relative value of ploughing, or inverting the land, and the breaking up or cultivating; and although the simple smashing or breaking up of the soil by the tines of a cultivator was but little appreciated, there can be no question that the opinion of those best qualified to judge, viz., those who have adopted steam power for cultivating, *is now decidedly in favour of the steam cultivator over the plough.*"

This opinion, it will be seen, refers exclusively to steam tillage, Messrs. Howard being the inventors and patentees of a great number of ploughs, designed for different purposes, but all of them on the same principle, adapted for turning over the sod in the same neat, unbroken, and handsome, but, according to their own expressed opinion, erroneous manner. What the tines of the steam cultivator effect upon the large scale, the Hancock plough does upon the ordinary scale of tillage, by animal power; and now that the farmers have waked up to the true nature of the operation, the machinists must reform the structure of their ploughs accordingly. We shall here give one more quotation from a work we have already referred to on the subject (Morton's "Cyclopædia of Agriculture"), it is to the following effect:—

"We need not state here the condition in which land ought to be left by the plough, either when it is intended for a seed-bed, or that it may be more speedily prepared for one. Both the farmer and the philosopher agree on this point. Whether the question be looked at by the eye of the practical, or of the scientific man, the answer given by each is the same in fact, however different the verbiage may be in which it is expressed. The one says the land should be in sound heart and healthy condition, and the other means the very same thing when he says that it should be in such a state that free access should be given to air and moisture, by which the manure and the soil may be rapidly decomposed, or the germination of the seed rapidly effected.

"Now, in considering what mode of ploughing will most rapidly and effectually bring land into this condition, it is evident we cannot reason from the operation as performed on land already in a loose state; there, indeed, no difference will be perceptible between the work of two very different implements. If we are to compare the work of two ploughs, it must be done on such land that the form and position of the sods, as each is cut and turned over, will be preserved."

The latter part of this passage refers, we presume, to a clover-ley of one or two years' standing, ploughed up at Michaelmas, for dibbling or drilling with wheat. It is evident, however, that the writer completely loses sight of the object which, in the former part, he states to be the aim both of the farmer and the philosopher; namely, *speedily* to prepare the best seed-bed. For, if the "form of the sod" is to be preserved in turning it over,—which, indeed, appears to be the chief object, both with the constructors of ploughs, and the judges by whom the prizes are awarded at the agricultural shows,—

then the speedy preparation of a seed-bed is sacrificed to the mere appearance of the surface; and whilst a well-pulverised soil is an essential condition of a proper seed-bed, the preservation of the form of the sod, which presents it in one hard, smooth, unbroken furrow-slice, leaves it in a very unfit state for the reception of the seed. It is no subject of wonder, while this system is persevered in, that the wheat crop should so frequently prove a partial failure.

We are led to conclude, from the general practice, that hitherto it has not been thought possible to procure a seed-bed with the plough alone, and at one operation. On no other principle can we account for the universal endeavours of the machinists to form an implement so ill adapted to that purpose. So long ago as the beginning of the present century, this subject was pointed out to them by Forsyth, in his work on Agriculture, with the view of stimulating their efforts to improve the plough. "It requires," he says, "the serious consideration of the most accomplished mechanician; but from him we *may* expect improvement. We have many data; we know pretty distinctly what preparation will fit the ground for being the proper receptacle of the seed, and for supporting and nourishing the plants; and though it is perhaps impossible to bring it into this state by the operation of any instrument of the plough kind, we know that some ploughs prodigiously excel others in reducing the stiff ground to that uniform crumbling state, in which it can be left by the spade. The imperfections of their performance, or what yet remains to be done to bring the ground to this state, is distinctly understood. It seems, then, a determinate problem (to use the language of mathematicians), because the operation depends upon the laws of mechanical nature."*

The above was written sixty years ago; and so far from "the most accomplished mechanicians" having employed their time and talents in discovering the mode of effecting the grand object of preparing the seed-bed by the plough alone and at one operation, not one of them has constructed one of those implements on a principle calculated to produce such a result, except in the instance we have named, the inventor of which was previously unknown as a machinist. Nor is it probable that at present the principal implement makers will alter their mode of construction. So much capital has been invested in the manufacture of modern ploughs, that they will scarcely make the desired alteration in its form, until compelled by the universal voice and requirement of the farmers themselves. It is probable the extension of steam cultivation will tend to hasten the change; the principal steam-plough manufacturers being now convinced of the superiority of Smith's "smashing-up system," as it is called, to common ploughing. We shall have occasion to refer again to this subject when treating on steam culture.

Having thus given our opinion on the subject of the nature and requirements of tillage, we shall describe next the characteristics of the different kinds of ploughs now in use. It would be impossible to notice even a moderate selection of the best that have been invented, which of itself would fill a folio volume. The reader will believe this when we state that at the meeting of the Royal Agricultural Society of England, at Cambridge, in 1840, one manufacturing firm (Ransome and Co.) exhibited eighty-two different models of ploughs of their own construction, for the farmers to choose from—rather a difficult task we presume; we can therefore merely describe the leading features of those ploughs most approved in different parts of the country.

Ploughs may be generally divided into *wheel-ploughs*, and *foot* or *swing-ploughs*.

* Forsyth's "Principles and Practice of Agriculture," 1804. Vol. i. p. 223.

The former require judgment in the ploughman rather than skill; the latter, skill rather than judgment.

There are two kinds of wheel-ploughs—the common one with high gallowses, chiefly in use in the counties of Norfolk and Suffolk; and the Turn-wrest plough, still the favourite in Kent, and some few other counties.

The old Norfolk Wheel-plough is of a very complicated structure, and requires much practice to use it with good effect. But this very circumstance, by calling into exercise the judgment rather than the skill of the operator, has imparted an intelligence and thoughtfulness to the ploughmen of those counties, which distinguish them from most others; and the work of a good Norfolk ploughman is equal to that of the most skilled of those who use the swing-plough. The correctness of the working consists in the proper adjustment of its several parts, which require to be regulated, as the work proceeds, with the irregularities of the surface of the soil. The *gallowses* consist of a frame of wood, of a square form, and running on wheels. Between the two upright parts, which are mortised into a strong square piece of wood, is a movable bar, sliding up and down the frame in a groove, being fastened with pins through the upright. On this sliding bar, the beam of the plough rests, and by raising or lowering it, the *depth* of the furrow is determined. A pin is also used on the upper part of the bar, which has different holes, by which the position of the beam may be altered, in order to regulate the *width* of the furrow. The stilt or handle of the plough—for a good Norfolk ploughman would disdain to have more than one—is firmly mortised to the head or base, from which also rises the beam. The share is fixed to the sock in the usual manner. The draught-chain is fixed to the lower part of the gallowses; and to the beam by a strong movable iron ring, which also assists in regulating the depth of the work; holes are pierced in the beam, in which is an iron pin, by moving which from one hole to another, the beam can be raised higher or let down lower, relatively with the height of the gallowses. The whipple-trees, or traces of the plough, are fastened in front of the gallowses. The ploughman uses reins, which are secured to the top of the stilt by a staple; and he guides the plough with one hand, carrying his whip in the other. One pair of horses only is used; and in the spring a one-horse plough is employed, with which a Norfolk man will, with ease, plough in two acres of barley in the day.

The objection to the wheel-plough is that much time is taken up in altering and adjusting the several parts, to meet the irregularities of the ground, and other incidental circumstances; also the weight of the whole machinery is urged against it. It is evident, however, by the amount of work that is performed with it, and the ease with which a pair of light horses will turn over an acre, and sometimes more, of land in the day, that neither of these objections save much weight practically, in increasing the demand of power; whilst the accuracy with which the operation is directed by the hand of a skilful practitioner is remarkable. We have frequently marvelled to see a Norfolk ploughman turn into one of the large *brecks** of that county, some of which are a quarter of a mile across; and, setting up a stick at one end, draw a furrow from the other end, straight as a line to it, guiding the plough with one hand, and the horses by the reins with the other, the docility and intelligence of the horses being, in *their* measure equally surprising; for horses accustomed to the work will seldom deviate much from the straight line.

* A *breck* is a local term for a field of any extent above forty or fifty acres.

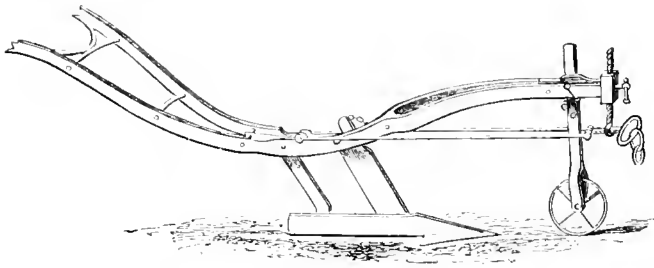
The old Norfolk wheel-plough was formerly made almost exclusively of wood, but of late years iron has been used in most parts of it. The two wheels also were originally of the same diameter, which caused the gallowses to move constantly out of the perpendicular. The reduction of the size, therefore, of the land-wheel is a great improvement; while the use of iron has enabled the manufacturer to lighten every part of the implement, and to reduce the draught very considerably.

The turn-wrest plough is differently constructed from the Norfolk wheel-plough, having two mould-boards, so that it can be worked continuously on the same tilth, by which means the land lies all the same way, and there are no furrows except the concluding one. There are several kinds of turn-wrest ploughs; and, latterly, the question has arisen whether, where the land is thoroughly drained, and not very retentive, there is any necessity for furrows? In the exceptional case, there may be some advantage in having deep furrows, to get rid of the surface water more speedily, after heavy and long-continued rain-fall. Deep culture, however, coupled with drainage, will, even in the worst or most retentive soils, modify the evil. The high ridges into which the land was thrown in some parts of the country, forming furrows so low that two lads standing on the opposite sides of the ridge could only just see the crown of each other's hats, indicated a style of farming "more honoured in the breach than in the observance." The steam plough will eventually work an important revolution in the cultivation of heavy land, whatever it may effect on the lighter soils, on which, at present, its use has not been much applied.

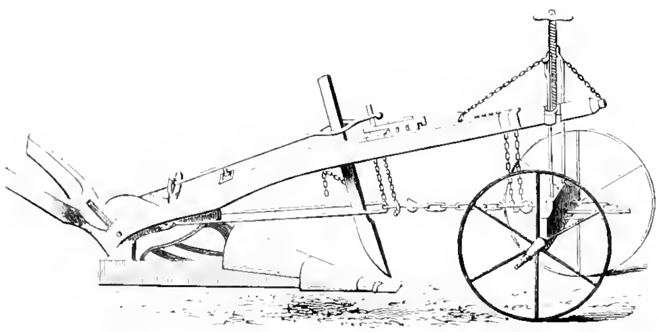
The old Kentish turn-wrest plough is a heavy cumbersome implement, having the high gallowses of the Norfolk plough. The difference between them consists in the construction and use of the mould-boards, or turn-furrows, and the "nose-piece" or "buck" and the share. This latter varies in width according to the work to be performed, and ranges from two to twenty-four inches; the latter being only used for cleaning the land. Notwithstanding the clumsy appearance of the Kentish plough, in the hands of a skilful ploughman it will make excellent work to the depth of eight inches, and a furrow of eleven inches in width. Four horses are almost invariably used in the plough in Kent.

A very efficient turn-wrest plough has been invented by Lowcock, and is being manufactured by Ransome and Co., of Ipswich. It has two mould-boards, placed end for end, by which arrangement there is no turning the implement at the end of the furrow. The draught-chain slides on an iron rod, so that when the plough arrives at the end of the field, the driver unfixes the handles or stilts (which are fastened to a hinge on the centre of the body of the plough), and turns them over to the other end of the implement. The horses also, at the same time, turn to the left or right (according to the direction of the land), and take their places at the other end of the plough, without unfastening them from the draught-chain, which slides along the iron rod, to its fresh place.

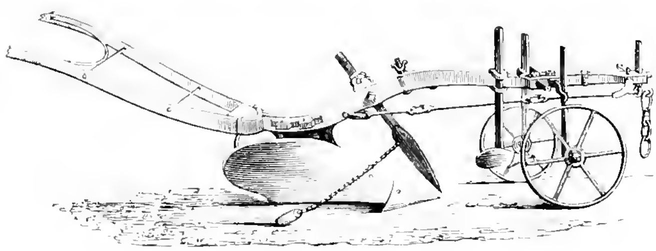
Smith, of Deanstone, also invented a turn-wrest plough in which the mould-boards are fastened together by a cross-bar, acting on a swivel at the top of the plough, and lifts either of the mould-boards out of the work, leaving the other in. Each mould-board carries its own share, so that each side is a complete plough. This implement has been a good deal used in Scotland, where the land is ploughed deeper in general than in England.



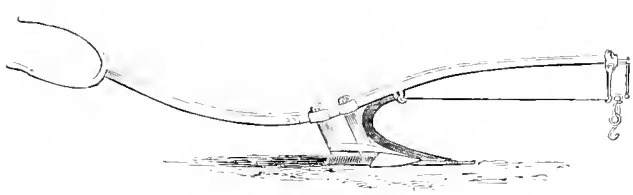
RACKHEATH SUBSOIL PLOUGH.



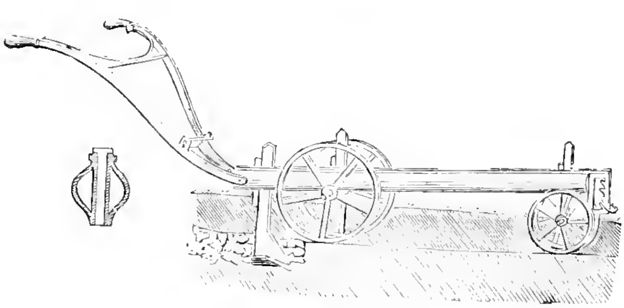
KENTISH TURN-WREST PLOUGH.



HOWARD'S PRIZE PLOUGH.



THE DEANSTON SUBSOIL PLOUGH.



REED'S SUBSOIL PLOUGH.

The ploughshare was formerly made of wrought iron, but in 1785 Mr. Robert Ransome, the founder of the firm of Ransome and Co., of Ipswich, obtained a patent for manufacturing cast-iron shares, which were very soon in universal use in the neighbouring counties. Continuing to make improvements in both the form and composition, he obtained another patent in 1803 for making case-hardened shares, by adding a plate of steel, one-sixteenth of an inch in thickness, to the bottom of the share, and on the land-side point. The advantages of cast-iron ploughshares—consisting in cheapness, uniformity of make, facility of fixing, &c.,—gave them a decided advantage over wrought, or hammered iron, and Ransome's shares soon gained them a notoriety throughout the kingdom, which they have ever since maintained. It was previously seldom that a farmer could obtain two wrought shares alike, even when made by the same smith; and on the other hand, there were few country blacksmiths who understood the nature and requirements of the ploughshare in regard to form, which ought to vary with the character of the soil; a stony soil requiring a pointed share, and a free soil a more angular one, &c. But since cast-iron was introduced, when a farmer has once discovered the exact form of share that suits his land, he can obtain the same at all times, in any number, and without the least variation in form or manufacture.

The modern wheel-ploughs, invented by Ransome and Co., of Ipswich, and Howard and Co., of Bedford, are entirely made of iron, and formed on scientific principles, so as to reduce both the weight and the draught. There are many other eminent makers, as Barrett and Exall, of Reading, Hornsby and Co., Grantham, &c. The latter have introduced a plough which obtained the first prize at Leeds, and which we shall describe presently. It may be said that the great majority of prizes for ploughs at our public shows, have been gained by Howard and Ransome; and those two firms appear to obtain the largest amount of the public patronage for their ploughs. As, however, the number of ploughs of different construction, made by either of these firms, is very large, we shall describe only those of most general utility.

In their address to the public, calling attention to their "Champion Ploughs," Messrs. Howard state that in instituting improvements in that implement, they have invariably kept in view the following objects:—

"1st. To make a plough that will cut and turn the work in the best manner, and suitable to the greatest variety of soil.

"2nd. To obtain a form, the lightest in draught, and that will work the cleanest on sticky soils.

"3rd. To substitute wrought iron for cast, where practicable, so as to render every part strong and durable, without unnecessary weight.

"4th. To make every part free from complication, and to fit those parts subject to wear or breakage, in the most simple manner, so that an ordinary ploughman shall have no difficulty in replacing them when in the field.

"5th. To make *the* plough that can be kept in order at the least expense, to which end J. and F. Howard have paid great attention to the quality of their shares, and other wearing parts."

In conformity with these conditions, the following description of the construction of the several parts of their ploughs will explain to the reader how they are fulfilled:—

"The ploughs are made principally of wrought iron, and are as light as they can be made consistently with durability. The beams are ribbed or flanged at the hinder part, which gives great strength where most liable to strain. The handles and beams are made throughout in a piece, which prevents their shaking loose, and also the soil from accumulating in the hinder part of the plough.

The frame, or body, into which the lever-neck is fitted, is formed so as to stand the roughest usage; and the lever-neck is so boxed in, as not to be liable to wear or breakage. The socket of the share is made plain on the under side, which not only effectually prevents its bursting, but causes the plough to run smoothly on its sole.

The shares are fixed to hair-necks of wrought iron, made upon an improved principle, the raising or lowering of which gives the point greater or less *pitch* or inclination, as the share wears, or as the state of the land requires. The superiority of this lever-neck consists in its being tightened at the end instead of being fastened by a bolt through the side; and when raised or lowered, which can be done instantly, it is firmly secured in a series of grooves. The accumulation of earth inside the plough, in most instances, renders a lever useless, as it cannot be removed without a great deal of trouble. But in this arrangement, by simply taking off the end nut, it may be at once disconnected from the plough, and anything preventing its free action removed.

"The wheels, which are unequal in diameter, are fixed to the beam by strong bars, attached to the uprights of the frame by sockets and screws; and, passing through the beam, are also fastened to it by strong screws. Some of the ploughs have both wheels made to expand, whilst in others only the furrow wheel expands, the object being to arrange the width between them according to the width of the furrow. The wheels are capped both behind and in front, which prevents soil from getting to the axles, and also the grease from escaping. This is a very important improvement, and both reduces the friction and causes the wheels and axles to last much longer.

"The breasts or mould-boards are made on exact geometrical principles, so as to work clean on adhesive soil, and to reduce the draught. The coulter is fastened by a malleable iron clip; it is strong and simple, can be adjusted instantly, and being made to slide on the beam, the angle of the coulter can be altered as required. A skim coulter is attached by a wrought iron clip, and is useful in ploughing clover-leys and stubbles. The draught-chain is attached to a wrought iron rod, which being fixed strongly to the frame of the plough, passes through a ring at the head. The rod is jointed at three parts to give more freedom to the action of the plough."

Such is the construction of the Howard Champion Plough, and the best commentary upon the correctness of the principles on which it is founded, is the fact, that in ten years Messrs. Howard have manufactured fifty thousand, and have received from the Royal Agricultural Society of England fourteen first prizes for the three classes of ploughs.

The ploughs manufactured by Ransome and Co., which is, we believe, the oldest firm in the trade, are the result of many years' study and reflection; and the high position they have attained as machinists and implement makers in every part of the world, is the best proof of the excellence of their work, and the efficiency of their machines and implements. Their ploughs, the variety of which we have referred to above, are fitted to all kinds of work, from turning a furrow five inches deep and eight inches wide, to one of twelve inches deep and eighteen inches wide. Most of them have trussed beams, that is, composed of two bars, strongly clamped together with bolts and screws. The draught-chain is mostly fixed to a hake at the end of the beam, and scrapers are attached to the uprights or wheel-shanks, to clear the wheels from soil as the work proceeds. There is, in most respects, a strong similarity between Howard's and Ransome's ploughs, and the latter firm has been awarded as many first prizes, within one, by the Royal Agricultural Society, as the former. The Lowcock iron turn-wrest plough, made by Ransome and Co., is a very efficient implement for hill-side ploughing. It is a great improvement upon the old Kentish plough, obviating all the objections to that cumbrous machine; and though strong enough for four horses, may be worked on moderately strong land with two, the weight being only $2\frac{3}{4}$ cwts.

The plough invented by Messrs. Hornsby and Sons, Grantham, demands a special notice, from the success which attended their first attempt to compete with the great implement makers who have been for so long a period in the field before them. The principal feature in the construction of this plough is the attachment of the share and the mould-board to the *sole* or *slade,* instead of to the frame, as is common in other ploughs. The advantage of this is, the facility it gives of making the beam, the handles, and the frame all of solid pieces of wrought iron. The fore part of the sole is made hollow, and provided with a spherical bearing. Into this the end of the lever-neck is inserted; and, as it also is made spherical, it fits closely into the bearing, preventing the entry of dirt or soil, which would interfere with its free action. The part of the lever beyond the spherical bearing, passes through a conical opening, admitting a free movement of the lever in all directions. The back end of the lever is attached to an adjusting *snug,* this snug being itself adjusted to any desired height, by a bolt which passes through a curved *slot,* and is secured to the back of the framing. The snug is provided with a horizontal slot, in which a bolt is attached to the end of the lever-works; by moving this, the lever-neck is impelled in a horizontal plane, the movement in a vertical plane being obtained by moving the snug in the slot of the framing. Thus, any required degree of adjustment of the lever-neck is easily obtained; and with it an adjustment of the share, which is attached to the lever-neck so as to give it more or less inclination to the soil, or a side movement pointing it more or less to the land. The land side of the plough is of greater length than the sole or slade, which secures an ease of draught, or uniformity of depth, and a facility for keeping the plough in a straight line when at work.* This plough, to the surprise of all the competitors, especially the great manufacturers of ploughs, gained the first prize at the Warwick meeting of the Royal Agricultural Society in 1859, for both light and heavy land ploughing, and a second prize for general purpose ploughing.

The foot, or swing plough, is less used in England than it once was; but in Scotland, where stronger made implements are necessary, there are several kinds in use, as Small's† in East Lothian, Barrowman's in Fifeshire, Clarke's in Stirlingshire, Wilks' in Lanarkshire, &c. All of these have their advocates, and probably each is best suited to the nature of the soil on which it is used. Those made by the English machinists are generally similar to the wheel-ploughs, *less* the wheels. But so little are they in demand, compared with the wheel-ploughs, that the catalogues of the two large makers to which we have already referred, contain only two specimens each; and the proportions in numbers manufactured by them, compared with the wheel-ploughs, are respectively, Howard and Co., 1 per cent., and Ransome and Co., from 8 to 10 per cent.* On the strong

* R. S. Burn, in the *Journal of Agriculture,* October, 1859.

† Small's plough has been in use in Scotland above eighty years, and is still the favourite in the Lothians.

lands of Essex and Suffolk, the swing-plough is still used for throwing the land into small high ridges—a necessary process in the absence of thorough draining, in order to get rid of the surface water.

Morton states the following as the advantages of the swing-plough :—" 1. It admits of being set into its work at a given depth, either shallower or deeper, by the alteration of the draught-iron at the point of draught, or by increasing or decreasing the distance at which the power of the horses is applied. 2. The ploughman has also the power of regulating, in some degree, the depth of the furrow, by either lifting or bearing upon the handles. 3. It is a plough of more simple construction than any other, and less expensive in its first cost. 4. A skilful workman can plough across the ridge and furrow at very nearly an uniform depth. He can work with it almost all lands, and in all weathers when ploughing can be done at all."

The perfection of form, and efficiency of working (according to the present ideas of the requirements of a plough), to which all the machinists have arrived in the construction of their ploughs, is such, that the superiority of one over another appears to be purely accidental, depending upon, possibly, a slight difference in the structure of some apparently unimportant part, or on the peculiar adaptation of an implement to the soil, or to the skill of the ploughman, &c., &c. All profess to make them on purely scientific principles, and with due regard to the laws of mechanics and gravitation. The truth of our remark is shown by the list of prizes for ploughs at Warwick, which runs as follows :—

Light Land Ploughs.	Prize.	General Purpose Ploughs.	Prize.	Heavy Land Ploughs.	Prize.
Hornsby and Sons . . .	1st.	Howard and Co. . . .	1st.	Hornsby and Sons . . .	1st.
Ransome and Sons . . .	2nd.	Hornsby and Sons . . .	2nd.	Howard and Co. . . .	2nd.
Howard and Co. . . .	3rd.	Ransome and Sons . . .	3rd.	Ransome and Sons . . .	3rd.
Hensman and Son . . .	4th.	Bushy Agricultural Society	4th.	Ball	4th.
		Hensman and Son . . .	5th.	Bushy Agricultural Society	5th.

The plough of Messrs. Hornsby and Sons appears to have deviated more than any other from the general construction of the implement of the most celebrated makers, by which it has gained greater sharpness, whilst a sharper curve of the mould-board disposes of the furrow-slice in the most expeditious manner.

It is now, we believe, generally admitted that nothing is gained by increased length of the plough. Upon a first reflection it might be supposed that by extending the mould-board without increasing the breadth at the hinder part, the sharpness of the angle from the point of the share would add to the facility of turning the sod, and require less force to draw the plough through the ground. But besides the process of cutting and lifting, the plough must also *shove* the earth on one side, and by increasing the length of the mould-board we increase in proportion the quantity of earth to be thus acted upon. It is found that the power necessary for thus forcing a body of earth horizontally along the ground is nearly equal to its weight, while it remains upon the

* Messrs. Ransome state that swing-ploughs preponderate in Essex, a few are used in Suffolk; they are common in Lincolnshire, and generally are used on strong lands, where wheels would clog; on stony rocky lands, where ploughs are often thrown out of work; and on new or uncultivated grounds, where the roughness of the surface precludes the use of wheels. Messrs. Howard state that swing-ploughs prevail partially in Essex, Cheshire, Lancashire, and Lincolnshire; and still more in Yorkshire, Cumberland, Durham, and Northumberland.

mould-board; nothing therefore is gained by the elongation of the plough, but a greater facility in first penetrating the earth, which is the work of the share and coulter; while the implement itself is rendered heavier, requiring more power to draw it, and the soil is turned over, especially if an adhesive one, in a condition unfavourable to its after comminution. On the other hand, it has been found that increased steadiness is gained by increasing the length of the sole, and the action of the plough is less affected by the inequalities of the ground, and the occurrence of stones and other obstacles. The main objects, therefore, in the construction of the plough should be facility of cutting and penetrating the sod; sufficient weight and length of frame to secure steadiness of motion; and a quick riddance of the furrow-slice in such a state as to facilitate the subsequent operations in forming a seed-bed.

The coulter should, in all cases, be made of wrought iron, with a steel edge; about 2½ inches wide, 2 feet 10 inches long, and thick enough to resist the concussion of a stone or other obstruction. The lower end should be curved on both front and back, forming a point in the centre, although some are made curving only to the front. The land side should be straight or flat, but the furrow side tapering from the back to the edge. The angle at which it should be set should vary according to the work to be performed. It may be set at forty-five degrees for unploughed land, as clover stubbles, old pastures, &c., but in ploughing fallows and loose ground, it may be upright, or even still more backward. Skim coulters are frequently used in ploughing stubbles; and on breaking up old pastures, a wheel coulter is also employed, having a steel cutting-edge. The point of the common coulter should be exactly on a line with the point of the share, and, when ploughing land free from stones, an inch or two in advance of the share; but if the land is stony, the point ought to be almost in contact with it, otherwise a stone may fix itself between them, and throw the plough out of work, or, at least, interfere with its free action.

A friction-wheel has been introduced of late years into the body of the plough, the object of which is to lessen the friction of the sole, and to regulate the depth of the furrow by fixing more precisely the pitch of the plough. Whether the first object is not obtained (if so at all) at an expense of greater friction, and encumbrance to the implement, by the additional weight of the wheel, and the accumulation of soil it necessarily gathers when the land is wet and sticky, is a serious question. If the plough actually bears upon the wheel sufficiently hard to relieve the sole, the friction must be great upon its axle, and will very soon wear it loose enough to give it an irregular and oscillating motion, very injurious to the steady action of the implement. Even, therefore, if the friction on the sole does exist to the extent supposed—which is doubtful, in the case of a well-constructed plough—applying the wheel appears to be a remedy as injurious as the disease.

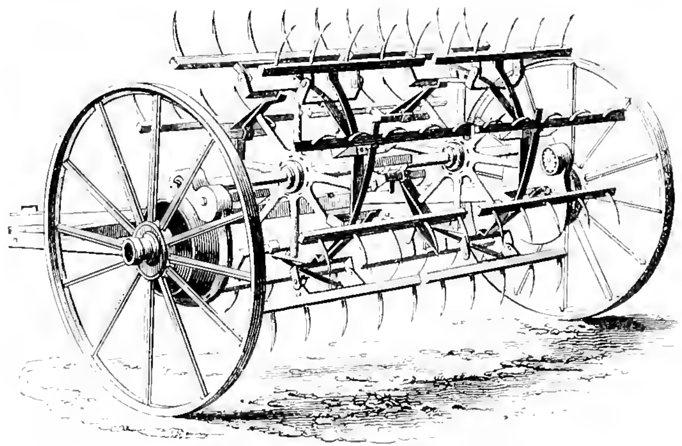
The double-breasted plough was, we believe, first used in Northumberland, for throwing the land into single-bout ridges, on which to drill turnips, mangold-wurzel, &c. The usual plan is, to form the land into such ridges, and then deposit the manure in the furrows; after which, the ridges are split by the plough, which turns the soil over the manure. The seed is deposited on the top of the ridge, a light roller being attached to the drill in front, to level the soil before it. Since the introduction of condensed manures, this mode of sowing is less practised; but the double-breasted plough is useful for throwing the stubbles into ridges after harvest, that the soil may receive as much benefit as possible from the frosts of winter. It is also used for moulding up root crops, beans, peas, &c., and for setting out water furrows. The breasts or mould-boards are usually made to expand or contract, so as to regulate the width of the trench, according to the purpose for which it is intended.

Subsoil-ploughs are coming more and more into use every year. They are generally made for stirring, not bringing up, the subsoil, and usually follow in the furrow made by the common plough, going to the depth of from six to eight inches, or more, below it. The benefit of thus opening to the air the hitherto impervious *pan* formed by the action of the plough for centuries, and affording facility to the roots of plants to penetrate freely into new ground, is now almost universally admitted; and that the more the air is allowed to permeate the soil, the more vigorous will vegetation proceed. The old notion that to break through the *pan* would destroy the ground, is become obsolete, and deep tillage and subsoiling, coupled with thorough drainage, are the acknowledged tests of high farming and good husbandry. Besides these beneficial advantages, subsoiling, by opening and loosening the earth, allows the escape of the surface water with greater speed, and thus prevents it from chilling the soil and retarding the growth of the plants: and when performed on land well drained, tends to advance vegetation more than manure. The temperature of land thus treated will always be some degrees higher than that of land undrained, and with the subsoil undisturbed.

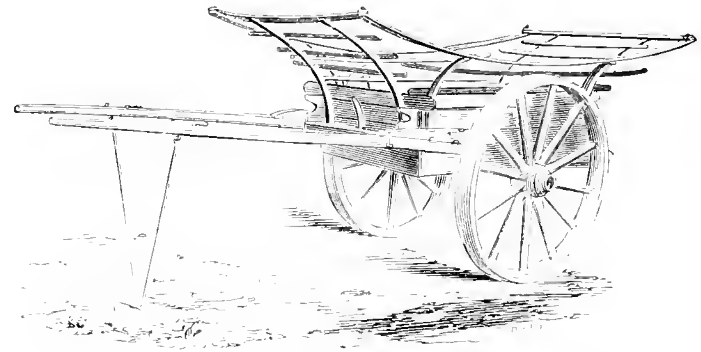
SECTION VI.

THE CULTIVATOR.

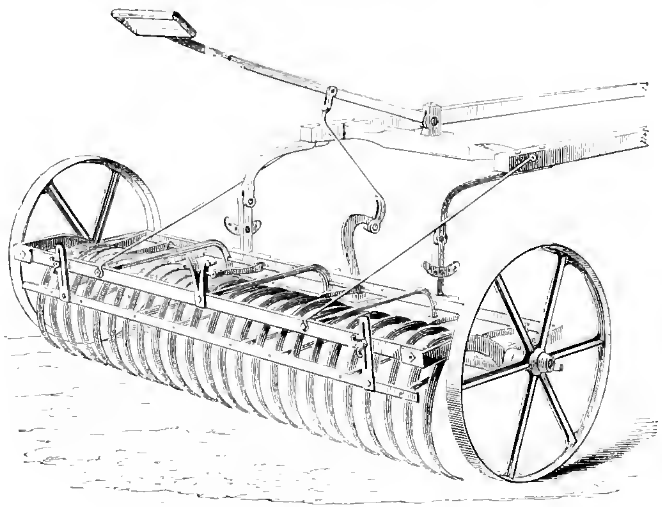
This implement is also called a *Grubber* and a *Scarifier*, in which latter capacity it is equally useful. It was first invented by a Mr. William Lester, of Northampton, to whom was awarded for it a silver medal from the Society for the Encouragement of Arts. It is exceedingly probable that the inventor took the hint from the harrow, of which it was a modification; the frame being raised on wheels, to regulate the depth of its working, and the tines elongated and rendered more oblique or curved forward towards the points. The frame was, in the first instance, made in an exact triangular form, and the teeth or shares so placed on it as to cut or disturb all the ground to the required depth. Great improvements have of late been made in it, both in the form of the frame and the tines. In number these range from five to eleven, and they are either sharp-pointed or have a broad spatula instead. The pointed tine is perhaps most adapted to pierce the subsoil, into which it enters; but it is a question whether the broad tines do not more effectually disturb the whole of the ground through which they pass. The form, too, of the frame is now either triangular, semi-square, or of any form, according to the taste of the maker. Cross-bars are also introduced, to which the tines



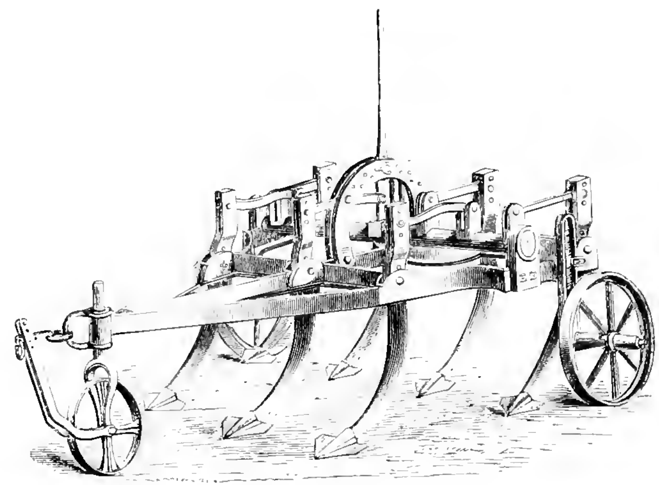
HAY-MAKING MACHINE.



HARVEST CART.



HORSE DRAG RAKE.



DRAG HARROW CULTIVATOR.

are fixed, instead of to the outside frame only; and they usually have two or more sets of tines, from pointed to broad, to suit the work they have to perform.

The broad-edged tines are used in paring the stubbles, in the first instance, for the purpose of cutting up the weeds and twitch grass; and when these are got rid of, the narrow or pointed tines are put on, to open and stir the land. In the spring it is again brought into requisition, to cultivate the land to the depth of the furrow of the previous ploughing. In this operation the pointed teeth are also used, by which the twitch grass and other weeds are brought to the surface, to be collected by the harrows afterwards, these being also used previously, to level the ground in order that the cultivator may act uniformly upon the whole of the soil. The small five-tined implement requires only two strong horses; but those with seven tines, or upwards, cannot be worked with less than four horses, or more, according to the number of tines and the condition of the land. They are now made wholly of iron, sometimes cast, and at others wrought or hammered. The latter are the lightest; but it is a question whether the weight of the cast-iron implement is not an advantage, enabling it to take a more firm hold of the soil, and to work with more steadiness. It requires, however, more power to work it, but it costs considerably less.

There are several different modifications of this implement, all of which have at different times received testimonials to the excellence of their working. The following may be considered the most approved by the public:—

Barrett and Exall's Cat's-claw-drag.
Kirkwood's Grubber.
Ransome's Indian Cultivator.
Uley's Cultivator.
Biddell's Scarifier.
Finlayson's Harrow.
Coleman's Cultivator.
Smith's Grubber.
Cottam and Hallen's Scarifier.
Earl Ducie's Cultivator.
Tennant's Grubber.
Burtall's Broad-share Plough.
Howard's Scarifier.

The form of the teeth has much to do with the efficiency of the cultivator, and this varies with the kind of work to be performed, being either pointed or more or less broad, whether in the arrow-head form or flat and square. Kirkwood's Grubber was, we believe, the first invented with an apparatus for lifting the tines out of the work, by elevating the frame to which they are attached. It was in 1830 that this implement was brought out in its improved efficient form, and it has been subject to few alterations since that period to change its character. The principal new feature is the extension of the axle of the hind wheels, which, in the original machine, was so short as to place the wheels close to the lever. By lengthening the axle, they are now on the outside of the extreme tines, and besides this advantage, by giving the machine a wider basis, it is rendered far more steady in working.

The frame and the carriage constitute two distinct parts, connected together by means of the apparatus for raising the tine-frame, and a joint rod, which is common to both. The whole, except the wheels, are made of wrought iron. The tine-frame is, in form, an irregular triangle, one of the sides being extended beyond the apex, in order to receive the fore wheel attached to the lifting apparatus, which is placed between the clamps of the tine-frame, and secured by a bolt, which acts as an axle. A rod is fastened to the upper end of the bar of the fore wheel, and reaches to the other end of the frame, where it is connected with the handles of the machine by two strong bars.

The lever is attached to the lifting apparatus, which, when the machine is at work, remains in a slanting position. By pulling the lever, the tines are lifted out of the work, being elevated by the fore wheel and the straightening of the apparatus at the hinder part of the frame. The extreme length of the tine-frame is 6 feet 6 inches, and the extreme breadth, at the wide end, 4 feet 2 inches. The tines, of which there are seven, are $1\frac{3}{4}$ inch by $\frac{3}{4}$ inch in thickness, curved towards the point, which is flattened out to $1\frac{1}{4}$ or $1\frac{1}{2}$ inch in breadth. In length they are 20 inches, and can be set to any depth their length admits of, by an iron wedge.

The carriage consists of the axle, which bears the two hind wheels and the two handles or levers, through which it passes, and is fixed by cotterels on each side. To the levers are attached the joint rods, at the distance of $13\frac{1}{2}$ inches from the centre of the axle. Two upright bars, termed the "bridle," are also bolted to the levers to act as a fulcrum to the joint-rod, to which they are attached, when it is necessary to lift the tine-frame out of the work. The levers are $4\frac{1}{2}$ feet in length from the axle, and are terminated by wooden handles, being united to, and supported near, the ends by a stay and a curved bar. The hind wheels, which support the carriage, are 22 inches in diameter; and *that* supporting the fore part is 13 inches in diameter, and works upon a crank lever. It is the curved form of this lever, which is attached to the front of the tine-frame by a pin which assists to raise the frame out of the work, the upper end of the lever being joined to the connecting bar, with which it acts.

All those cultivators or grubbers comprising an apparatus for lifting the tines out of the ground, have taken Kirkwood's invention for the model, altering or improving upon it according to their own ideas of its requirements. There are, however, considerable differences in the form of the tines, some being more curved than others, and some having a broad share, with two wings or flanges. Tennant's Grubber has a swan-necked tine, curving upwards from the frame about $3\frac{1}{2}$ inches before bending downwards, by which arrangement the weeds, instead of accumulating at the top of the tine, are carried over the top of the supporting bar, when forced upwards by the action of the tine upon them. It has an angular end, and is 2 inches broad at the widest part of the end or spatula, $1\frac{1}{4}$ inch thick at the back, and $\frac{7}{8}$ths of an inch at the front, which is rounded.

Coleman's Cultivator is rather a favourite with the farmers. The frame of this implement is of wrought iron, and is 6 feet in length by 2 feet 10 inches in width at the hinder part. It has five tines swung on bolts $\frac{3}{4}$ inch in diameter. The front wheel is 16 inches diameter, and the two hind wheels 2 feet 4 inches. The barrel-spindle is hollow, and 2 feet 10 inches long. It works in sockets at its ends, and has snugs projecting from its upper side. These are connected with the tines by the upper ends of the connecting rods which are inserted in the mortise-holes in the snugs and fastened by pins through corresponding holes. The other ends of the connecting rods are inserted in the mortise in the upper part of the tines, and also secured by pins. The tines are attached to the frame by bolts or pins, passing through a hole, of which there are several to regulate the depth of the working. The tines are 2 feet 10 inches in length, are made of wrought iron $2\frac{1}{2}$ inches broad by 1 inch thick, and are *considerably curved*. They are supported by the central bar, which is acted upon on its centres by a handle, which moves in a slot of the semicircular guard, and is retained in it in any required position by passing a pin through corresponding holes in the guard and handle. It is worked with shares, spuds, or points, according to the work required to be done, and ranging from $1\frac{1}{2}$ to 12 inches in width.

Bentall's Broad-share Cultivator, was invented by Mr. E. R. Bentall, of Heybridge, Essex, and is extensively used for eradicating weeds, and opening the soil of the stubble lands. The beam is of wrought iron, with a cross-bar bolted to it, on which move the hind wheels, whilst the fore wheel is fastened to the beam. There are three tines, the centre one being fixed to the beam, and the other two to the cross-bar at equal distances from the beam end. The stilts, or handles, are secured by a bolt to an iron stay attached to the cross-bar. Scrapers are provided for the purpose of keeping the wheels clear of soil. This implement is made very strong, and is exceedingly useful in clearing the stubbles of all kinds of weeds, and preparing the land for the spring ploughing.

Finlayson's Grubber has a lever connected with the fore wheel at one end and reaching to the hind part of the implement, where it is supported by an upright curved bar. When it is required to lift the tines out of work, the conductor bears upon the lever, which brings the bar of the fore wheel up, and lifts the tines out of the ground. When this implement was invented it was much employed, others of more simple and less cumbrous construction having almost driven it out of use in its original form, but an improvement of it by Scoular is much in use in Scotland.

The Uley Cultivator is a very efficient implement. The tines in this invention are lifted out of the ground by a worm turned with a handle and acting upon a wheel. The handle being turned round, moves the cog-wheel which is fixed to the axle of the hind wheels. To the axle-wheel is also fixed, by a pinion, the uprights of the frame which bears the tines, so that by turning the wheel, the frame is acted upon; and for every inch the axle-wheel is thus turned the framework is lifted half an inch; and the next upright, half way between the ends of the frames, being also lifted an inch, the fore part of the frame is also lifted half an inch. The time occupied in working the axle-wheel, which must take several turns of the worm to produce the effect, is the only objection to this plan, which, in other respects, is very efficient.

The Uley Cultivator is made wholly of cast-iron, and is consequently much heavier than if wrought iron was used. It is, therefore, much cheaper; but at the same time requires more power to work it, especially when the land is moist, and the narrow wheels sink into the ground. It is said that the additional weight gives steadiness to the implement, and a more firm hold on the ground. But it is estimated that of two machines of five tines each, the Uley Cultivator requires three horses to perform the work that another of wrought iron would do with two. Notwithstanding this drawback, the Uley Cultivator, improved by Earl Ducie, has received several first prizes—a proof that the excellence of the work compensated for any defects the implement might in other respects possess. Morton is of opinion that if the light form and simple leverage of Scoular's Finlayson-Harrow could be combined with the higher framework and better arrangement of tines of the Uley Cultivator, it would be superior to any other implement of its class now in use. And as the value of this description of machine is much higher appreciated than formerly, he recommends that attention should be paid to the improvement of this form of it, in order to remedy its known defects.

Messrs. Howard, of Bedford, have invented a wrought iron Zigzag Lever Scarifier, the frame of which is made of ribbed iron, strong and light. The tines are arranged in a zigzag position, which diminishes their liability to choke where the land is foul, while their form prevents them from cutting or breaking the couch-grass roots into short lengths, rather drawing them out from the loosened soil and leaving them on the surface. The implement is raised out of the work by merely releasing the lever, when the advance of the horses instantly lifts the tines out of the ground. The number of tines is from seven to eleven, and the weight of the whole from $4\frac{3}{4}$ to $6\frac{1}{2}$ cwt.

The original Cultivator, invented by Lester, had points about its construction which, perhaps, it would have been well not to have lost sight of. Its purpose was the pulverisation of tenacious soils that have been once ploughed, and was a very simple implement. It consisted of a straight beam, at the hinder part of which were two handles. A semicircular cross-bar was fixed to the beam near the lower end of the handles, and at each end were a number of holes. Two strong bars, movable at the fore part upon a pivot, which united them to the beam, expanded themselves to form an angle, the hinder parts being rested upon the cross-bar, to which they were secured by pins in the holes of the bar, and corresponding ones in the side bars. These were made to expand or contract by moving them nearer together or further off, on the cross-bar. Three wheels, one in front and two behind, all of iron, bore the implement, and seven shares or tines were fixed to the side-bars at regular distances. The depth to which the machine worked, was regulated by raising or lowering the iron bars of the wheels in their sockets in the cross-bar.

When the machine was employed on fresh land, the side-bars were expanded as widely as the length of the cross-bar would admit. As the soil became looser they were brought nearer, so that the shares were placed closer, and pulverised the soil more effectually. "In working a rough fallow, therefore, the Cultivator should be set for its greatest expansion, and contracted in proportion as the clods are reduced." It was asserted by Lester that one man and a boy with six horses, would do the work as effectually as six ploughs; and a Mr. Shaw, of Cotton-End, in Bedfordshire, who, in 1800, used it on a turnip fallow, was able to scuffle off seven acres per day with six horses.

It appears to us that this faculty of expansion and contraction is a principle which ought not to have been abandoned in the improvements that have been made in the construction of the Cultivator—especially where only one is kept, as it would do away with the necessity of a second, which to a small farmer is an object. There would be no difficulty, we presume, in combining this principle with the present improvements of the machines. The only objection to it was, that by the contraction and expansion, the points of the shares were in a slight degree moved out of the direct line; but this does not appear to have been any impediment to its working.

After the first invention of the Scarifier by Lester, it appears to have lain in a manner dormant for many years, few having been found to avail themselves of it; until Mr. Pusey, who saw at once its value as a cultivating machine, gave his opinion of it to the public. This brought it into general notice, and since that time it has become an object of attention, both with the farmer and the machinists; and these latter have modified it to suit every possible method of stirring and cleaning the soil. There are now few large farms without the Cultivator or the Grubber; and the successful efforts of Mr. Smith to apply it in connection with steam-power, has given it a still wider sphere of operation. It is worthy of observation that Mr. Pusey foresaw this application of it, as he showed by the following passage: "I will venture to say, what may appear theoretical, that if ever steam be successfully employed in cultivation, it will probably be less by ploughing or digging, than with an implement like one of these cultivators." Whether Smith took the hint from this remark, and constructed his Steam Cultivator according to it, we know not; but, certainly, as we shall be able to show when we come to treat of steam culture, his "smashing-up" system is a practical illustration both of the penetration of Mr. Pusey and of the value of the Grubber as a cultivating implement.

SECTION VII.

STEAM CULTIVATION.

The application of steam-power to the purposes of husbandry, and especially to that of the cultivation of the soil, is now an accomplished fact, patent to every one. Its introduction into the manufacturing industries of the country, and as a propelling power for the conveyance of travellers and merchandise, made it only a question of time when it should be applied also in agriculture, so as wholly or partially to supersede animal power. The advantages, inherent, direct, and collateral, resulting from its use are so great that wherever it has once established itself there is no receding. More than that, having been applied in what may be called an experimental trial to husbandry, it cannot stop at that point. It was a favourite saying of the inventor of railways, that "Steam and the rail were man and wife, and that no power on earth ought to separate them."

It will be said that Stephenson was a railway man, and that the rail was his hobby; that he saw the application of steam only through a railway medium. This may be true, but the remark was not the less just. And in regard to husbandry, no one will venture to affirm that the present modes of applying steam to the cultivation of the soil are fulfilling its ultimate mission; and that nothing remains to be done but to improve the present methods of application. The inventors have not hitherto got beyond *adapting the power to the condition of the land,* and are therefore compelled to resort to a clumsy and roundabout way of accomplishing the object, very little less expensive than the plough, and requiring a combination of horse-power, man-power, and steam-power. It is a question indeed, whether the small saving of expense by the present use of steam-power is not more than absorbed by the excess in the general expenses of the farm.

We are aware that the benefits arising from even these applications of a new power, in the more effectual, more expeditious, and more timely preparation of the land, are productive of larger crops, and therefore make ample amends for the expense of steam-power, even if it be greater in the aggregate than that of the plough. The same might have been urged by the railway companies for charging the passengers as high or higher fares than those under the stage-coach system. They might say, "You travel quicker, by which you save time, and are enabled to transact more business, and your merchandise is received in one-fourth of the time it formerly required in transit; and are not these sufficient advantages without any reduction of expense?" But whilst it is clear that railways can convey passengers and goods at less than half the expense of the ancient systems, the public would scarcely tolerate a scale of charges equal, or approaching, to those under the reign of the old stage-coach and waggon.

We may apply this reasoning to the use of steam in husbandry, and affirm that it will not have fulfilled its mission until it reigns *alone* on the farms, and has cheapened the processes of husbandry to a scale commensurate with those of the common railways, which now intersect England with a network of iron, affording facilities of locomotion undreamt of by our forefathers, and banishing almost every other mode of travelling out of the country. In like manner, steam-power in husbandry must eventually supersede all other power, except that of mind; and to this consummation must both the machinist and the agriculturist steadily direct their attention and their efforts. We look upon the present state of the question as a transition one, and the attempt to adapt steam-power to the existing conditions of the land, as a struggle to bend an unyielding agent to incongruous circumstances. The immense lengths of ropes, the drums, the anchors, and the whole paraphernalia of the present cultivating apparatus, have nothing essentially to do with steam-power, which is of too simple a nature to require, or put up long with, such clumsy, and, at the same time, complex arrangements. This struggle however, irrational and unphilosophical as it is, will still continue until the true mission of steam is comprehended by the agriculturist, and the conviction dawns upon his mind—*that instead of adapting steam-power to the condition of the land, this latter must submit to such modifications as shall prepare it for the important change which the supremacy of steam-power involves.* The land in fact must yield to steam as its master, and look forward to the union of the "man and his wife" on its surface as the "*ultima thule*" of steam culture. When that event is consummated—and that it will be so, sooner or later, we feel assured—the land will be cultivated infinitely better than by, and at *one-third of the cost* of, the present system; whilst the produce will be enormously increased. The labour of the farm, though not less in aggregate amount, will then be intellectual rather than onerously manual—calculated to raise both the moral and physical character and condition of the peasant, and tending to husband his powers, increase his usefulness, and lengthen his existence.

One of the most important results of the application of steam-power in husbandry, is the facility it affords for deep culture and subsoiling. This may be considered a modern invention, for the time is not long past when it was looked upon as almost sacrilegious to break through the pan and intrude upon the sanctity of the subsoil. There are some farmers still who do not believe even in thorough draining, and who look upon the subsoil as holy ground, not to be touched by the profane hand of the ploughman; yet this is one of the most important improvements of the present day, and is conducing more than anything else to the amelioration of the soil, and the increase of production. The following remarks on this subject are taken from Stephens' treatise "On Deep Land Culture," and are much to the purpose:—

"In common practice the surface soil devoted to the use of plants seldom exceeds seven or eight inches in depth, and of that space a good manuring of farm-yard dung occupies a considerable portion. This, assisted by a special manure, stimulates the growth of the roots of the cereal plants to an expansion beyond what the soil allotted to their growth affords room for. Roots in a confined space, supplied with manure, become crowded together, decline in health, and their growth is checked. The plants may still bring forward their produce to a fine degree of quality, but it will neither be so large nor so valuable as the manure bestowed, and the labour spent on the soil, would warrant the expectation of. Whence, then, does such an unexpected disappointment arise? From the subsoil, though thoroughly dried, being left in a hard state. Were it in a state of pulverisation, like the surface soil, the roots, whenever stimulated by the manures, would strike down into the subsoil; and the more they were encouraged in growth, the larger they would become, their fibres would increase in numbers, and they would stretch out and reach the bottom of the pulverised soil. The crowding of the roots in the surface of the soil would be entirely avoided, and the baneful consequences of loss of health and stuntedness of growth in the plant, would be replaced by vigour of stem and leaves, strength of constitution, and capability to yield the largest quantity of produce. Were farm-yard dung buried deep in the pulverised subsoil, and the embryo plant encouraged in the pulverised soil by means of a special manure, the limits of the growth of the entire system of the plant—stem, leaves, and roots—would then only be restrained by the power of the local climate, or the general character of the season."

Scott Burn, also, writing on the same subject, says:—"As to the value of a thorough pulverisation of the soil, agriculturists long divided, are fast approximating in opinion. Few, indeed, are ignorant of the immense advantages resulting from allowing the atmospheric influences to act upon the soil; but some still incline to the opinion that it may be carried too far, more especially when in combination with thorough drainage; this opinion being held in consequence of supposing that, in the case of heavy rains, the soluble matters will be washed out and conveyed to the drains, which then, in point of fact, will act as sewers, to carry off the fertilising matter from the land in the same way as street sewers carry off the exuviæ of towns.

"Those who urge this objection are not aware of, or do not consider, the absorptive power of soils, by which they divest the rain-water, not only of the fertilising matters taken up from the manures, but also those which the rain-water itself brings, from the atmosphere. Recent experiments, by the most eminent chemists, have demonstrated this absorptive property of soils, which also is increased by the action of the atmosphere. Now, it is only by deep culture and opening up the subsoil, that its aeration can be effected. Undisturbed, it must, if at all adhesive, remain impervious to the roots of plants, and unameliorated either by the action of the air, the manure, or the rain."

That plants require a depth of loose mould to root in, beyond the six or eight inches usually allowed them, is manifest wherever they have the opportunity of pushing downwards. We have seen the roots of wheat taken from the side of a gravel-pit six feet in length. Lucerne will strike down twelve feet in such a soil, but will not thrive at all in a clay soil, where the subsoil has not been disturbed. The turnip and mangold-wurzel are equally anxious to seek their nutriment from the subsoil, as well as from the upper; and, in point of fact, all our cultivated vegetables exhibit the same tendency, and by an increase of vigour prove the benefit they derive from deep tillage.*

Another advantage derivable from deep culture and perfect pulverisation of the soil, is the more uniform moisture of the land whether by attracting the dew from above or

* The writer once occupied a field, part of which had been trenched with the spade; the rest ploughed in the usual manner, six or seven inches deep. The difference in the crops was perceptible for at least twelve years, which was the time he held the land after operation. The subsoil was a gravel.

the evaporation from beneath. It is well known that a well-comminuted and drained soil is some degrees warmer on the average than an undrained and imperfectly tilled one. This phenomenon is easily accounted for. Whilst heavy rains pass through the one, leaving only the fertilising effects behind, the dews are attracted from above, and the vapours from beneath, and both are retained, so that in drought the well-cultivated soil suffers nothing in comparison with *that*, under which the subsoil is impervious, leaving the six or seven inches above it to all the inconveniences of a burning sun and the absence of moisture.

It is gratifying to see that these opinions begin to prevail amongst the farmers, who were formerly opposed to such innovations. So recently as ten years since, one of the most eminent of these gave it as his opinion, that "the test of perfection in the work of a plough is, that the furrow-slice shall lie, after being turned over, in a perfectly straight line, not only unbroken but even uncracked." If *appearance* was everything that is required this agricultural magnate was right. But the question is, how long would a stiff clay, thus laid in brick-fashion, have to continue exposed to the atmosphere—especially in a wet time—before a harrow would have any effect upon it? and how many subsequent operations would be required to bring it into a proper state for a seed-bed? These are questions which do not appear even to have entered the mind of the person referred to; yet they are vital ones, which have since received such a solution as has exposed the absurdity of the opinion, and the little acquaintance of him who asserted it with the nature and requirements of plants, or of the soil on which they are grown.

SECTION VIII.

STEAM CULTIVATION—ITS HISTORY

We can go no further back than to the beginning of the seventeenth century to find the first problem put forth of the application of steam as a motive power. In the year 1618 David Ramsay and Thomas Wildgosse patented an invention comprehending "Newe, apte, or compendious formes or kindes of engines or instrumentes, and other profitable inveneons, wayes, and meanes, for the good of our commonwealth, as well as to ploughe grounde without horses or oxen, and to enrich and make better and more fertill, as well barren peate, salte, and sea-sand, as inland and upland grounde, within our Kingdomes of England and Ireland, and our Domynyon of Wales; as also to make boates for the carryage of burthens and passengers runn upon the water as swifte in calmes, and more saff in stormes, than boates full-sayled in great wyndes." This patent was renewed, or others taken out, in 1630 and 1634; but it does not appear that Ramsay was able to persuade his countrymen of the feasibility of his plans. In fact, the little knowledge possessed at that time of the physical sciences, renders it more than doubtful whether it was possible to carry out the plan with efficiency and safety. At any rate, Ramsay was born two hundred years before his time, and his invention died with him.

Ramsay appears to have had a contemporary, if not a competitor, in William Parham, who, in connection with other persons, patented a similar invention, extending also to ploughing without horses or oxen; and forty years after, Francis Moore took out several patents for machines dispensing with animal power in culture and navigation. He professed to draw coaches and waggons with it, to do ploughing, harrowing, and every other branch of husbandry, and to use it in manufactures where horse-power was employed. These inventions also appear to have attracted little attention, or, at least, little support, and to have died a natural death, without leaving behind them any records of the modes of working them.

About one hundred years later, Richard L. Edgeworth, an Irish gentleman, the father of the celebrated Maria Edgeworth, produced an engine, carrying an "endless road" with it, the plan and construction of which were very similar to those of the engine patented by the late Mr. Boydell. Many other schemes of a similar character were started towards the close of the last and beginning of the present century, when Watts' genius had given to the steam-engine an endurable standing in the country. But although manufacture had answered the call to prepare for those wondrous changes which have since taken place in its industrial arrangements, the time was scarcely arrived for agriculture—always the last to submit to innovation—to adopt a system which would upset all its preconceived ideas and opinions, and hand it over to a power, then itself in its infancy, of which it knew nothing, except that it was really dangerous in the hands of unskilful persons. All the systems up to 1832, of which there were many, proved abortions, although some of them, in the hands of a Fowler or a Howard, might have been rendered available. In that year Mr. John Heathcote, a lace manufacturer in Devonshire, and a member of Parliament, brought out and patented his celebrated plan for draining and cultivating land by an entire new set of machines and apparatus.

Assisted in his undertaking by Josiah Parkes, afterwards consulting engineer to the Royal Agricultural Society of England, Mr. Heathcote brought out his engine on the 1st of April, 1834. It appears that he intended it specially to cultivate and reclaim bog-land, for on this occasion he drove it over a mile and a half of undrained bog. A plough was constructed by Parkes and applied to it in 1836, which, on being tried, performed admirably, laying the furrow-slice as straight as an arrow, being the first time known at present of land having been ploughed by steam. Mr. Howard, from whose paper on the history of the steam-plough we have taken these particulars, is of opinion that had Mr. Heathcote and Mr. Parkes adapted their invention to ploughing on ordinary land instead of to the reclamation and cultivation of bog-land, they would have succeeded. As it was, after expending £12,000, it was given up. Yet the plan was very similar to those which now engage the attention and meet the approbation of the public. It consisted of an engine travelling along the headland on one side of a field, and an anchor on the other side. When working on bog-land an "endless web" for forming a road was used. The cultivating implements were drawn backwards and forwards on the same plan as in Fowler's system; and it is probable that all the more modern systems now in use are modifications of Heathcote's. The Highland and Agricultural Society of Scotland awarded to Mr. Heathcote £100 towards defraying the expenses incurred in exhibiting his machinery at Dumfries in 1837. The Society had offered a premium of £500 for the first successful application of steam-power to the cultivation of the soil. They approved of Mr. Heathcote's "Plough" on trial; but it did not quite come up to their ideas of successful culture, and they did not award the prize.

In 1849 Messrs. Barrett and Exall, of Reading, in connection with Mr. Hannam, a well-known agriculturist at Burcote, near Abingdon, constructed what must be considered the first apparatus invented for working ploughs or cultivators by the ordinary portable engine, and the first attempt to plough the land by an engine stationed at the corner of a field or outside it. This was the original "roundabout system," as it is now called, in which wire ropes, 1,600 yards in length, were used, and were coiled and uncoiled by a windlass with two drums, or winding barrels, as is now practised in Smith's and Fowler's systems. It was set to work practically; but after ploughing sixty acres, at the rate of five acres per day, the rope broke, and other difficulties intervened, which induced the projectors to abandon it altogether. In this case, Mr. Howard thinks that if steel wire rope had been used, and more perseverance exercised, this machine would have proved a success.

The next machinery demanding notice is that of Lord Willoughby D'Eresby, who, at the Great Exhibition of 1851, presented a complete set of steam-ploughing apparatus. It had an engine with winding barrel for each headland, which travelled, as the work proceeded, on a tramway of planks. The ploughs, which were on Lowcock's turn-wrest principle, were drawn from engine to engine with a chain, which latter arrangement appears, according to Mr. Howard, who saw it at work, to have been the fatal cause of a want of success. The plough frame contained two sets of ploughs, pointing in opposite directions, and easily lifted out of the ground by means of racks and pinions. The engines were alternately employed in drawing the plough-frame backwards and forwards, the frame itself running on wheels which regulated the depth of the furrow. This plough performed four acres a day with a furrow nine inches deep.

We are now arrived at that point at which steam cultivation assumed a practical form, and, with the apparatus employed, was admitted into the economy of the farm as an acknowledged part of its machinery. The struggles that had been made, and the immense sums expended in accomplishing this object, show the importance that was attached to the principle, but at the same time display the mistaken apprehension entertained by the projectors, both of the true mission of steam-power and of the treatment the land ought to undergo in order to facilitate the accomplishment of that mission. It is a subject of deep regret, that although some of the projectors were men of fortune, and could, without inconvenience, spare a few thousand pounds in the working out of an experiment, others have ventured their all in the undertaking, and upon a failure, have found themselves bankrupts in fortune, with all the odium attaching to an unsuccessful experiment. Such, unfortunately, is the fate of a large majority of projectors of new machines, whose efforts prove abortive as far as themselves are concerned; and they are compelled to give way to others, who availing themselves both of the errors and the correct ideas of their predecessors, bring out the same class of machines, divested of what was worthless and with improvements of what is really useful. It would be invidious to mention individual cases in which the valuable parts of enterprises that had proved ruinous to the projectors have been—we will not say pirated, but—adopted by succeeding machinists, who have thus built fortunes upon the ruins of the unsuccessful. The failure of these projectors, however, leaves the coast clear for fresh men to start in a new career; and the public are equally obliged to them for perfecting that which was inefficient, although part of the merit was due to another.

The steam-cultivators at present in use, or that have been projected within the last ten years, are divided into the following classes:—

I. Those with engines travelling over the land, and drawing the cultivating implements after them.

II. Those with locomotive engines working on railways, and drawing the implements after them.

III. Those with stationary engines whilst at work, and drawing the implements by means of wire ropes.

IV. Those with engines moving along the headlands, and drawing the implements by means of wire ropes.

I. At first view of the nature of cultivation, it might seem, that the engine accompanied with the implements, travelling over the land together, is the most natural and the most direct mode of applying steam to the operation. Other considerations, however, of a more powerful nature were directly opposed to the plan, and it is now, we believe, universally abandoned. The weight of the machinery is so great that a shower of rain—as we have witnessed—was quite sufficient to stop the progress of the apparatus, whether carrying its own endless railway, or simply bearing with its wheels on the soil. The most noted of these were the machine of the late Mr. Boydell, which was a modification of that of Edgeworth, and the rotatory cultivator of Mr. Romaine. The first consisted of a ten or twelve horse-power engine, to which were attached four common ploughs, each separate, drawn by chains of different lengths, so as to work behind each other, and each held by a separate ploughman. To the wheels, which were ten inches broad, ran upon an "endless railway," attached to them in such a manner that each section fell under the wheel as the several parts approached the ground. The enormous weight (ten tons) of this machine passing over the soil inflicted as much injury almost as the ploughing did good. It soon became evident that the plan must be abandoned; and the "Boydell Steam-plough" is now used successfully for drawing heavy weights on the common roads, for which it is well adapted.

Mr. Romaine's machine was on nearly the same principle as Boydell's, except that it had no endless railway, and that it carried a "rotatory cultivator," calculated to dig rather than plough the soil. The weight of the whole apparatus (fifteen tons) was an insuperable objection to its use as at first applied. We have seen the wheels make a rut in a piece of clover stubble baked for weeks by the sun. What, then, must be the effect upon land that has been soddened with water, but on which a common plough-wheel would make no impression. This and other objections have induced Mr. Romaine to abandon the plan and adopt the rope traction, but with what success we are not able to state.

II. Of those with engines working on railways, the only plans are that of Lieutenant Halkett, R.N., and that of Mr. Grafton, which is a modification of Halkett's, with whom he had formerly been connected.

Mr. Halkett's system, which he calls "the Guideway system of Cultivation," as it fulfils all the conditions required for carrying out the mission of steam-power in agriculture, demands a special notice. For, whatever machinists may say, or agriculturists think, of the impossibility or impracticability of the system, it is the only one that is calculated to establish steam as the sole motive power on the farm, and to reduce the expenses of husbandry to a par with those effected by it in manufactures and on the public railways. That the first expense is heavy we admit; and also that the general habit and ideas of the agriculturists in that respect have not hitherto been such as to prepare them for expending £15 or £20 upon the land in order to prepare it for a system of cultivation, the advantages of which have never been tested except by the projector on a small scale. Convinced, however, as we are, that sooner or later the "guideway system of agriculture" will be taken up by the landed interest, whether owners or occupiers merely, as the only one that fulfils all the requirements of steam-power in its application to agriculture, we shall explain fully the nature of the system, its operations, and the advantages that would accrue from its adoption.

First. Mr. Halkett proposes to lay down the land with rails upon the common principle of the public railways, only at the distance of fifty or more feet from rail to rail. These are laid upon a foundation of brick twenty-one inches in width and two feet in depth. At each headland are rails, laid at right angles with the others, and low enough to receive the working machine or platform, in order to *shunt* it to fresh ground when it arrives at the land. These cross-rails will be the width required for the machine to rest upon it, and must be continued at one headland, out of the field and to the homestead, to convey the apparatus thither when the field is finished. It should also be continued from field to field, to facilitate the removal of the machine when it is required to work on a fresh field. The rails are, of course, permanent, being fixed to sleepers inserted in the brick-work, the two upper courses of which should be set in cement. It would be necessary to lay the land in square fields; whether separated by hedges or other fences, remains with the owner of the land to decide. It would be best, perhaps, to have it open, as then one headland would be enough for two fields, which would save a considerable expense, and would also square with the prevailing opinion that the less fencing on a farm the better, except it be of wire or iron rods, easily removed. Such is the preparation of the land required by the system.

Second. The working machinery consists of a platform, the length of the space between the rails, on which it rests by eight wheels at each end. This platform is made of strong timber to be capable of both bearing the weight put upon it, and of withstanding the strain to which it will be subject from the action of from six to twelve or more ploughs attached to its framework below. At each end of the platform is stationed a steam-engine, of five or more horse-power, connected together by an iron shaft and a set of gearing, so that they may work in unison with each other. The ends are connected with the wheels, of which there are sixteen, in such a manner that they act simultaneously as driving, as well as running wheels, by which arrangement the machinery can ascend any rising ground with a gradient less than the point at which iron slips on iron, which has been ascertained to be one in five. The action of the wheels on one side is allowed a certain amount of play on the axles, to allow for any little inequalities there may be in the space or gauge between the rails. By the distribution of the weight of the platform over so many wheels the pressure on the rails is much lessened, and it requires a lighter description of iron in their construction than if the whole weight rested upon two wheels on each side. The engines are such as are commonly used on farms, and may be employed in any other kind of work—as threshing, root-cutting, grinding corn for cattle food, &c., when not engaged in the field work.

Such is the machinery and arrangements of the guideway system of agriculture; and it is evident that when once it is fixed, any kind of cultivating or other implements may be attached to its framework below and worked with far more exactness and certainty than by any other methods, whether by hand or by machinery. Double the number of ploughs are fixed to the frame than are required, the same as in Fowler's system, half of them only being let down at once, which are taken up at the end of the land and the other half let down to return with the platform. But the distinguishing feature of the system is, the multitude of operations that can be performed with it as well as ploughing. Thus Mr. Halkett carried out most effectively on his land at Wandsworth, the following processes, viz.:—Ploughing, subsoiling, harrowing, rolling, clod-crushing, drilling seed dry or with liquid manure, hoeing, scarifying, watering crops, either on or below the surface, cleaning and pulverising the land, carting and distributing farm-yard or artificial manure, reaping, mowing, and carting of crops, both of corn and hay, and the conveyance of root crops to the homestead. These operations may all be performed without the intervention of a single horse in any one instance; consequently there is no treading on the land, no cutting it up with cart or waggon wheels and horses, nor treading of workmen except when pulling the roots, making the hay, or tying up sheaves in harvest time, after the machine. When once the land is prepared for the seed, it remains in the same fine state of tilth as long as the corn continues growing, all subsequent operations, as rolling, hoeing, &c., being performed by the machine, so that no condensation of the soil or injury to the plants can take place. These latter may be termed the *negative* advantages of the system. We shall now describe the more positive benefits it confers upon agriculture, and these are comprehended under the following heads:—Precision of operation, economy of time and labour, concentration of power, perfection of work, and universality of application.

1. *Precision of Operation.*—This advantage is secured to it by the rails, which prevent the possibility of the implement of whatever kind, when once fixed in its place to the platform, making any deviation from its proper course. The machine travels as direct as a train of carriages on the common railway, and with far less danger of accidents by reason of the slowness of its movement, and the weight of the whole machinery. A plough or other implement, it is true, may break under too great a strain, otherwise it must necessarily move on the precise line parallel with the rails. In hoeing, for instance, the hoes have been fixed within half an inch of a row of plants, the entire of which it passed without touching one of them. This is a most important point, as every farmer knows who uses the horse-hoe, the correctness of working which depends on the constant vigilance of the driver and steadiness of the horse. How often is a part of a row of plants cut up through the momentary carelessness of the lad, or from the horse taking fright, or even from the implement being thrown out by a large stone or other obstruction—accidents, which can never happen to the implement fixed to the guideway platform.

2. *Economy of Time and Labour.*—The saving of time is effected, not only in the large amount of work performed in a given time, but in the system being almost independent of atmospheric influences, no state of weather, except that of a severe frost, being an obstacle to its working. There being no necessity for the pressure of the foot of man or beast, or of any wheel carriage, on the land during its operation, it can be performed in any state of the land, whether wet or dry. This is a point of great importance, at certain seasons of the year, when it is absolutely necessary to the success and productiveness of the future crop that the land should be ploughed and the seed

deposited by a certain time. In breaking up stubbles, too, in the autumn, the timely performance of which is of far more importance than the state of the soil, the farmer is frequently compelled by the weather to delay the operation until the spring, by which the unstirred and unopened soil loses the ameliorating influence of the winter's frost and snow. The saving of labour will be appreciated when we state that the Guideway Cultivator requires only two men and a boy to conduct and manage it. With this small staff, the whole of the operations enumerated above, may be performed with the most perfect ease to the workmen, whose only business will be to attend to the engine, supply it with water, regulate the speed, and shunt it when it arrives at the end of the land. Thus the remainder of the staff of men on the farm will be liberated to attend to other operations and improvements, as draining, levelling, &c., &c.

3. *Concentration of Labour.*—The undeviating precision secured by the rails, renders it as easy and safe to work by night as by day. In this respect it stands upon the same footing as the common railway on which carriages run night and day. With relays of men, which, as so few are required, is easily arranged, the work of ploughing or any other may be carried on throughout the twenty-four consecutive hours, and thus double the amount may be performed. On a farm of a thousand acres, the patentee calculates that twenty-five acres per day of twelve hours can be ploughed, and, of course, double that quantity if worked the twenty-four hours. This is a consideration that any farmer well knows how to appreciate, as one that will enable him to get in his seed whilst the weather is favourable. It may be safely asserted that, with the Guideway Cultivator, a farmer would never need to be behindhand, under any circumstances, with his work, because it could be carried on continuously without regard to weather.

4. *Perfection of Work.*—This quality is also secured by the fixity of the rails, and the uniform movement of the platform and the implements attached upon it. When once these latter are fixed in their places, nothing except breakage, which all implements and machines are liable to, can prevent the work being performed in the most exact and perfect manner. Whatever operation may be in hand, the same undeviating regularity is provided for; and, moreover, the work of ploughing or other tillage operations is left in the same condition of fine deep tilth to which it has been reduced by the implements of husbandry, there being no after treading or poaching of the ground to undo what the plough has performed. The effect of obtaining, and still more of retaining, this high degree of tillage, upon the future crops must necessarily be most beneficial. It is well understood that a perfect comminution of the soil increases its power of absorption from the atmosphere of the elements of fertility, the principle of which was first started by Tull, before chemistry had enabled men to demonstrate its truth otherwise than by its general effects, but which has of late years been scientifically proved, and it is now considered the basis of good husbandry. Hitherto, however, physical obstacles have existed to render it impossible to carry out the principle to perfection. The treading of men and horses, and the wheels of heavy vehicles cutting up the soil, and above all the action of the plough-sole upon the subsoil, creating a hard pan at the bottom of the furrow, are drawbacks upon the best performances of the plough, and injurious to vegetation. These are all got rid of by the use of the Guideway Cultivator. Some of our best farmers have lamented that our knowledge of the principles of vegetation has shot ahead of our ability to carry them out, and that the means of a proper mechanical division of the soil are lamentably deficient. Mr. Halkett has solved this problem to a

greater extent than any other person, and his system would bring the cultivation of the soil as near to perfection as we can hope to attain. At any rate he has adopted the only principle at present known that is capable of effecting the object desired; and with regard to the future, we may use the words of Mr. Wren Hoskins, "*Given, the accomplishment of the act, the rate of intrinsic improvement in the art is almost foredetermined.*"*

5. *Universality of Application.*—We have already in some measure anticipated this property of the Guideway Cultivator, and it requires little more to be added. Besides the various operations we have enumerated above, there are several more which must necessarily be performed by hand, such as dibbling, transplanting, thinning, hand-weeding, cross-hoeing, &c. In order to perform these a board is fastened at the back of the platform low enough for a man, lying or sitting, to reach the ground; so that, without treading on the prepared soil, he can complete these and other operations in husbandry that require manipulation. The Guideway system of cultivation, therefore, is capable of performing or facilitating every operation of husbandry, without the intervention of horse-power, and with such a reduction in the employment of manual labour, as to divest the business of the husbandman of its most onerous duties; requiring the exercise of his intellectual, rather than his physical, powers; and at the same time reducing the current expenses of the farm to a scale on a par with those in all other departments of industry in which steam has superseded animal power. We therefore assert, without fear of contradiction, that the Halkett system is *the one*, and the only one, that fulfils the mission of steam in agriculture.

Mr. Halkett had proposed three different modes of laying down the rails, namely, with iron, wood, and brick. Upon more mature reflection, he gave up the two last materials as not adapted to the principle of his system, and the iron rail is the only material which he now advocates. The following is his calculation of the comparative expense of working a farm of 1,000 acres on the Guideway principle and the present one:—

GUIDEWAY SYSTEM.

First—Iron rails at £20 per acre capital.					
1,000 acres at £20 per acre		£20,000			
	£		£	s.	d.
Interest on capital at 4 per cent.	800				
Repairs and renewals at 2 per cent.	400		1,200	0	0
Farming capital for stock, consisting of locomotive cultivator, with 25-horse power engines, and shunting apparatus complete, £1,900; implements, £300.					
Interest, therefore, on £2,200 at 15 per cent.			330	0	0
Ten trucks, £300; interest at 8 per cent.			24	0	0
Coals, 20*s.* per day for 250 days			250	0	0
Oil			10	0	0
Engine-driver, 4*s.*; man, 2*s.*; boy, 1*s.* per day			117	0	0
Five constant labourers			155	0	0
Labourers for hand operations			50	0	0
Total annual expenses			£2,136	0	0

* In less scientific language, "when the right principle is discovered, no difficulty will prevent its being carried to perfection in practice."

PRESENT SYSTEM.

Statement given to Lieutenant Halkett, by a practical farmer and valuator, of the expenses of a farm of 200 acres of well-tilled land :—

	£	s.
Capital—8 horses, 4 ploughs, harrows, horse-hoes, scarifiers, 2 waggons, rollers, 4 carts, &c., £500.		
Interest and depreciation of stock at 15 per cent.	75	0
Horse keep—corn, 100 qrs.; hay, 30 tons	245	0
Labour—4 carters, at 12*s.* per week, £124 16*s.* 1 horsekeeper, extra, £31 4*s.*: 3 labourers, £105 6*s.* } -	261	6
100 acres of corn-hoeing, at 4*s.* per acre	20	0
Reaping 50 acres of corn, at 8*s.*	20	0
	621	6
Multiply by 5, for 1,000 acres		5
	£3,106	10
Deduct for saving in machinery on a large farm over a small one . .	30	0
Total annual expenses	£3,076	10

This latter estimate represents the farmer's present expenses for ordinary cultivation on the four and five shift system, exclusive of all extra labour for harvest, &c., not including all that could be done by machinery in the field. The comparative results, therefore, are as follows :—

	£	s.
Present expenses of a farm of 1,000 acres	3,076	10
Expenses of such farm laid down with iron rails on Guideway system	2,136	0
Difference in favour of steam	£940	10

The following scale of prices at which some of the operations of husbandry may be performed by the Guideway Cultivator, shows in what way so large a saving of expense in the management of a farm may be effected :—

COST OF THE OPERATIONS OF HUSBANDRY ON A FARM OF FROM 600 TO 1,000 ACRES.

	s.	d.	
Ploughing with 12 ploughs simultaneously, taking furrows 5 inches deep and 10 inches wide	1	7	per acre.
Hoeing 150 acres per day	0	3	,,
Scarifying, grubbing, &c.	0	8	,,
Harrowing, clod-crushing, rolling, &c.	0	5	,,
Drilling or dibbling seed	0	5	,,
Reaping and delivering corn at the rate of 60 acres per day .	0	8	,,
Underground watering of crops at the rate of 3,000 gallons per acre, and 60 acres per day or night, or double that quantity in 24 hours	0	8	,,
Surface watering with hoes following	1	2	,,
Carriage of manure on to and distributing over the land; and of crops taken off; also of marl, clay, sand, &c., at per ton	0	0½	per mile.
Deep culture to the depth of 25 inches, impossible by animal power	12	0	per acre.

Seventy tons of manure, or compost, may be carried at once by the machine.

As it is probable that some persons will question the possibility of reducing the expenses of a farm to the above scale, and the correctness of the estimates, which are those of the patentee, we will now examine the grounds on which the calculations are justified, and the certainty that they will be realised in carrying out the system.

Referring again to the infancy of steam-power in its locomotive capacity, it will be recollected that attempts were made in the first instance to propel carriages by it on the common highways; the idea of a permanent railway being then ridiculed, even in Parliament. When Stephenson suggested that it was quite possible to propel carriages with passengers at the rate of *fifteen miles an hour*, the proposition was met by the House with shouts of laughter. The first experimenters fell into the very natural error of endeavouring to adapt the new power to the existing medium of transit, instead of altering the latter to the requirements of the new power. The comprehensive mind of the late Mr. Huskisson led him at once to perceive the truth of the principle laid down by Stephenson; and the completion of the Liverpool and Manchester Railway proved that if steam-power was to be used for the transit of goods and passengers, it would necessitate an entire change in the medium on which it was to act. The experiment succeeded; for, notwithstanding the largeness of the outlay, which had so alarmed the House of Commons, the economic results proved that a saving of at least two-thirds was effected in both time and expense of travelling, as well as in the transit of merchandise. And what was the consequence? Why, that an entire revolution has been effected, in which the old tumbling apparatus of stage-coaches and stage-waggons were swept away; and instead of the turnpike roads the whole country, from the "Land's End to John o' Groat's," is threaded in every direction with railroads, at an outlay of capital amounting to fully half the national debt!

It is perfectly clear to us that the agriculturists, the machinists, and the Royal Agricultural Society, have, in the affair of the steam-plough, fallen into the same error as the inventors of the steam-carriage for the common highways. They have adapted the operation of the power to the existing system of the land, instead of reducing the latter to a form to meet the requirements of the power. By this error they confine the exercise of the power to one or two operations, when it is capable of performing *all* that a farm requires. And those which are effected by it, are conducted in so clumsy and irrational a manner, and with so small a reduction of expense in the long run, that nearly all the advantages of steam-power are still to come. That the result, so far as economy of expense, will ultimately disappoint those who adopt it, we firmly believe; and when, as in the case of the railways, the agricultural mind becomes enlightened as to the true character and mission of steam-power, it will look out for a more general and efficient system than the present ones of steam-ploughing represent.

Of the increase of produce that will result from the superior state of tillage assured by the Halkett system, we have said but little hitherto. But when all the advantages of it are taken into the account, this must be the most certain and the largest source of profit. Mr. Halkett, in a paper read before the Society of Arts in December, 1858, estimates the average increased value at £2 per acre, which is probably much below the mark. In his own field, which was laid down, as a practical model, with rails on a thirty feet gauge, the soil was comminuted, subsoiled, manured with a small dressing of guano, and planted with potatoes. The land on each side the rails was tilled in the usual manner, manured with an equal quantity of guano, and also planted with potatoes. Now, mark the result, both these plots produced one bushel per rod, or 160 bushels per acre; whilst that tilled and comminuted by the Guideway Cultivator produced *two and a half bushels* per rod, or 400 bushels per acre, giving an excess of 240 bushels, which at 70 lbs. per bushel, is nearly $7\frac{3}{4}$ tons per acre. This, at £5 per ton, is about £38;

enough to pay the expense of laying down the rails nearly twice over in a single season.

The facility of watering and of stirring the soil between the rows of plants without disturbing them, will add greatly to the increase of root crops particularly, they being frequently destroyed or seriously injured for want of moisture in the early stages of their growth. To market-gardeners such a facility of watering without treading on the land, and upon so large a scale, would be invaluable. Watering is one of the most expensive of their operations; but in a dry season is an indispensable one, and, as at present conducted, is frequently attended with much injury to the growing plants, in the passing to and fro of the persons watering, which is wholly avoided with the Guideway machine. Still more injurious to the gardeners,—and to farmers, too,—is the carting of crops in wet weather, which must be done when they are required, either for the market or for the use of the farm. Instances have been adduced in which the carting off of a heavy crop of mangold-wurzel in wet weather has so much cut up the ground as to render it impossible to get it ready afterwards for the reception of the plants for a crop of early cabbages, for which it was intended; and thus half a season was lost.

The great objection to this plan is the expense of laying down the rails and preparing the land. This is a bugbear that sooner or later will vanish, when the landed interest becomes more enlightened on the subject. Is it considered a hazardous speculation? It is no speculation at all now we know, not only what steam can effect in manufactures, railways, and navigation, but on the land as well. Even with the incongruous and roundabout systems now employed steam is working a revolution in husbandry. What, then, will it *not* do when "the man and wife" are brought together upon the land, which must eventually be the case? It is not in a country where four hundred millions sterling have been expended in thirty years upon one branch only of national industry, without any permanent or serious financial embarrassment, and where as much as *fifty thousand pounds per mile* have been invested in some lines of railway, that a system professing to embrace a certain economy of expense to the extent of from one-half to two-thirds of the present outlay of a farm will be ultimately rejected because it requires an outlay of £20 per acre. Besides, are farmers and landowners so unaccustomed to large outlays of money as to take fright at the Halkett system on that account? What is the expense of draining and subsoiling? What do water meadows and liquid manure distributors cost per acre? What amount of labour does a market-gardener expend upon his land? All these outlays are incurred, we presume, because they are well-known to be reproductive. Again, a farmer or a landowner will sometimes give £500 or £1,000 for a bull, *if he has a good pedigree*, because he knows that the cross will improve his own stock, and probably his neighbours', to the value of the purchase. Well, we can trace the pedigree of Halkett's Guideway Cultivator through thousands of miles of railway to the "Liverpool and Manchester" to establish its character—for its operation will be identical in principle; and as to the expense, the £500 or £1,000 given for the bull would at once lay down from 25 to 50 acres of land with rails, producing a far larger and more permanent source of profit. We feel assured that this "twenty pounds per acre" will eventually be considered no serious obstacle to the adoption of the system, which is but the extension of the same economic power to agriculture which has reduced, by more than one-half, the expense of every operation to which it has hitherto been efficiently applied.

The adoption, therefore, of this system by the landed interest we consider to be only a question of time, and that it wants but to be set going—whether upon a large or a small scale, is no matter—to come into general use. Eventually, we say, this *must be* the case; for as sure as the establishment of the very first railway demonstrated the advantages of that system and led to its universal adoption, so will the laying down of one farm on the Halkett Guideway system prove its economic superiority over every other mode of steam culture, and be followed rapidly on other farms or estates, until it has become the general system of cultivation in England.*

Grafton's system of steam culture is a modification of Halkett's, *less* the permanent rails. He adopts the platform of fifty feet reach, with an engine at each end; fixes the implements of husbandry in the same way, has a permanent rail on the headland to convey the machine home, or to shunt it from one part of a field to another. But instead of permanent rails across the fields, as in Halkett's system, he proposes to have an endless railway of vulcanised india-rubber, on which the propelling wheels, eight in number on each side, will run. No further preparation of the ground will be necessary than to take care that the line of road, on which the wheels are to travel, be kept perfectly smooth and free from obstructions, and also perfectly straight. The endless railway is a continuous belt of vulcanised india-rubber combined with flax threads, having wooden shoes about 12 inches by 18, shod with iron, fastened to it by a staple across the centre of each shoe, at right angles to the belt, which permits it to pass round the drums placed before and behind each series of wheels, and through the side girders under the engines. The rail is quite noiseless, and has no mechanical or metal joints (a defect to which nearly all machines of self-laying rails owe their failure); the strength and durability of vulcanised india-rubber fabric "is too well-known to need comment." The machine can be slightly but sufficiently guided when required, by the drums laying the rails being removed to the right or left by means of a circular lever, which also guides the leading wheels. In front of the drums and driving wheels is a spade plough, similar to a scraper before a common locomotive, but of a different shape, for the purpose of clearing a regular path and removing all obstructions, to permit of the rails passing evenly over it.

The headland rails are similar to those employed in Halkett's system, being of sufficient gauge to receive the working machine on two trucks, one for each end of the machine. On these it can be removed from one field to another, or to the homestead, or from one bout to another in the same field. To secure regularity in this respect the headland rails have distinct marks at every fifty feet, to serve as points from which the cultivator will start when one gauge of the land is finished. It is presumed by the projector that the wheels with the endless railway, passing constantly over the same ground, will, in course of time, form hard and permanent roadways across the field, about a foot and half or two feet wide, at intervals of fifty feet, taking no more land from actual tillage than the present furrows. Thus, the land will be cultivated in strips of fifty feet, upon which no pressure either of the cultivator or implements will take place. The

* The above is the larger portion of a paper written by the author for the *Edinburgh Journal of Agriculture* for 1859, and he has considered the subject of so much importance as to feel no scruple in giving it insertion in his work. Far from experiencing any alteration in his opinion on the subject, he daily becomes more confirmed in the conviction that no other system of steam culture can be permanent, and that the state of the landed interest is such that they will soon be compelled to adopt it.

space occupied by the headland, which the patentee states to be twenty-five feet, may be cultivated as grass land, fenced in with wire fencing to separate it from the arable land—the grass to be fed off by cattle or mown, as the farmer determines.

Having given the estimate of Lieutenant Halkett's expenses on a farm of 1,000 acres, it will be only fair to give those also of Mr. Grafton's. They are as follows:—

ANNUAL EXPENSES OF A FARM OF 1,000 ACRES CULTIVATED BY STEAM-POWER UNDER GRAFTON'S SYSTEM.

	£	s.	d.
Expense of interest and depreciation of endless railway, locomotive, and implements, costing £1,500, at 15 per cent. per annum	225	0	0
Coals at 20s. per day, 250 days	250	0	0
Oil, &c.	10	0	0
Engine-driver at 4s., and 2 attendants at 2s. per day	124	16	0
Five constant labourers	155	0	0
Labourers for hand operations	50	0	0
Total annual expenses	£814	16	0

ANNUAL EXPENSES OF A FARM OF 1,000 ACRES CULTIVATED BY HORSE-POWER UNDER THE PRESENT SYSTEM.
(*See* HALKETT'S ESTIMATE.)

	£	s.	d.
Total amount as stated pp. 599, 600	3,076	10	0
Ditto cultivated by steam	814	16	0
Difference in favour of Grafton's system	£2,261	14	0

Such is the Grafton system of cultivation, which, however, has not, that we are aware of, been practically tested on a small scale like the Halkett System, and the success must, therefore, be considered wholly hypothetical at present. We must, however, express a doubt, whether it can be successfully brought to bear in practice, for the following reason. One of the main points of perfection in Halkett's system, is the precision with which it operates, so that in hoeing, or any other operation, the implement may be set to within half an inch of a row of plants of any length, and will effectually hoe them without touching one of them. *This precision is secured by the rails in all the operations.* Mr. Grafton proposes to secure the same object by a set of wheels propelled in the same manner, without rails, but on a pathway supposed to be beaten hard by going over it ten or a dozen times in the course of the year. On this road, the wheels which have no certain guidance except their own exact movement and the direction of the engineer, must invariably keep the same line of route without deviating a fraction of an inch; because, if it do so to a lesser, it is liable to do so to a greater extent, and no dependence whatever could be placed upon it. Another objection may be urged against the roadways for the cultivator; for unless these are made firm and hard by artificial means, the few times that the machine will pass over them would scarcely be sufficient to produce that effect. In dry weather they would of course be firm enough; but ploughing and other operations must at times be performed in wet as well as dry weather, and we much question whether the weight of the machine would not sink it into the earth to an extent sufficient to embarrass its action. Or, if the soil be a hard clay, it is questionable whether the india-rubber rail would not slip aside when the pathway was wet, and thus throw the machine out of its course.

These objections, we admit, are, like the assumed perfectability of the system, suppositious. Of the durability of the india-rubber, we have no sufficient acquaintance with its action under such circumstances to judge. Mr. Grafton speaks of a brougham with *air-wheels* of that material, running upwards of 2,000 miles at the rate of eight miles an hour, whilst his machine will only make twenty revolutions per minute, and are so numerous (eight on each side) that the pressure, being equally distributed, will not produce the effect upon the material it would have if only one or two pairs of wheels were employed.

Notwithstanding the objections we have raised, it would be desirable that the system should be tested; for, if successful, the principal obstacle in the way of Halkett's system—the heavy expense—would be removed, and all the benefits it would confer secured by a moderate outlay. We cannot, however, so easily give up the judgment of the Prince of Steam-power, Stephenson, that "the rail and the steam-engine are man and wife;" nor can we conceive of the possibility of securing the benefits of the Guideway system *without the guideway*.

Thirdly. The class with engines, stationary whilst at work, and drawing the implements by means of a wire rope. This is called "The Traction System."

Of this class there are several; but by describing Smith's as the original one, and Howard's improvement of Smith's, the principle will at once be understood by the reader.

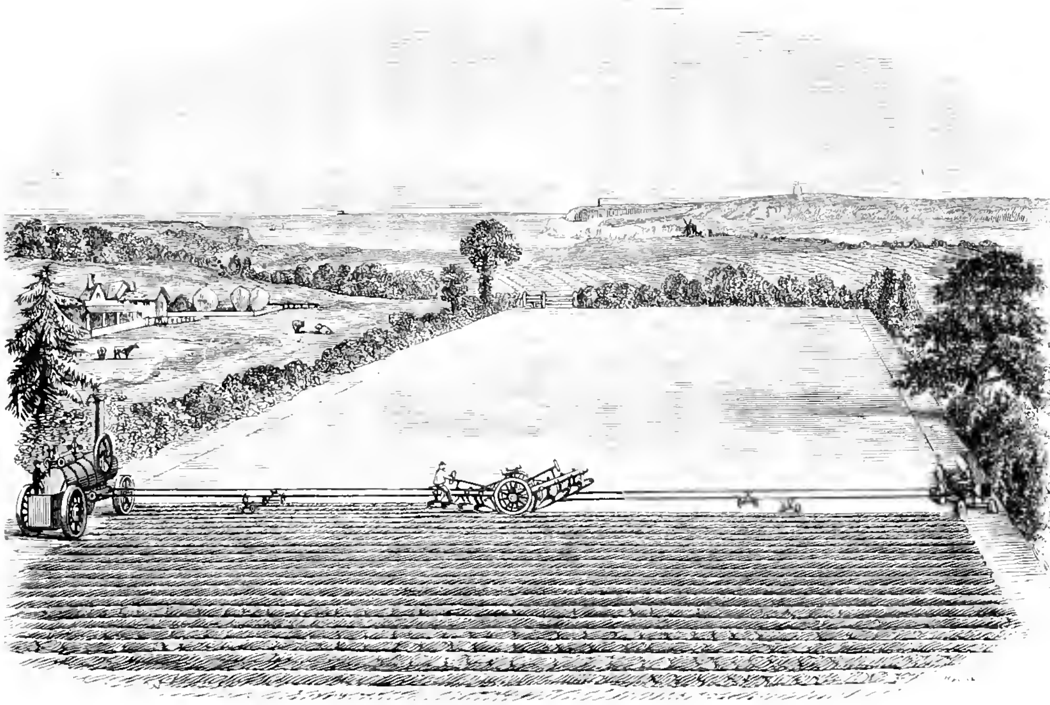
Smith's system is as follows:—The engine is placed on the headland of the field, with its windlass in front, the two being connected by a set of machinery to give action to the drums of the windlass for coiling and uncoiling the wire rope. A square of the field is marked out, at each corner of which is placed an anchor with a pulley to receive the rope. At intervals round the enclosure are placed rope porters with pulleys, to carry the rope, and prevent it from trailing on the ground. The rope is passed over these to the anchors at the three corners, the pulleys of which are sufficiently strong to bear the strain upon them from working. The dead of the rope, after passing the three corners, comes back to the windlass, and is received upon one of the drums. These alternately give out and receive the rope as the working machine passes backward and forward with the cultivating implement. This consists of a strong cultivator or grubber, of either three or five tines or shares, and it is attached to the wire rope at the farthest part of the square from the engine. Being set to work by the rope, it cultivates the soil from the first to the second anchor, at which latter it turns round, and the machinery being reversed, it travels back again on fresh ground to the opposite side. At every fresh bout of the cultivator the two anchors must be removed, to enable it to take new ground. The three-tined cultivator takes three feet of ground, and the five-tined about a foot more—the latter being calculated for light, and the former for heavy land. Both will cultivate or "smash-up" the soil to the depth of from 6 to 14 inches, leaving it in a highly pulverised state. When the whole square has been gone over with the cultivator, another is marked out in the same manner, and so on till the whole of the field is finished. A common plough, or a subsoil plough, can be attached to the machinery, if required. The latter will penetrate the subsoil to the depth of 22 inches. It may be worked by three horses, to the depth of from 10 to 14 inches. Mr. Smith has received numerous testimonials to the successful working of his steam cultivator; and to him, as we have already observed, is due the credit of bringing the value of the cultivator and its "smashing-up" operation, over the common or the steam plough, into public notice, and the testimonials he has also received, to the efficient working of his "tackle," are proofs of its utility. The engine used is one of eight or ten horse-power. If of greater power, the wire rope would not bear the strain. On light land eight acres per day may be cultivated, and five of heavy land.

Mr. Smith estimates that to till 225 acres of heavy clay land would require the work of an eight-horse engine forty-five days, and it would take thirty-five horses to perform the work in the same time, the expense averaging from 7*s.* to 10*s.* per acre, according to the nature of the soil. The number of horses that a stud may be reduced to is about two-thirds of the usual force; and the machine requires six men to manage it, namely, two to the engine and drums, two to the snatch-blocks or rope porters, one to the cultivator, and one to the anchors.

Howards' new patent steam ploughing apparatus is a modification of Smith's, of which they were formerly the manufacturers and agents, and is thus described by them:—An ordinary portable engine is used for working this apparatus. It is placed at one corner of a field, or on an adjoining field, and is connected by a flexible universal joint, or the common leather driving-band, to the windlass which actuates the plough or other implement, through the agency of steel-wire ropes, which last are led off from the windlass in any required direction; and thirty or forty, or even fifty acres are operated upon without any removal of the engine or windlass. The several parts of the apparatus are very strong and simple, and well adapted to hard work and the intelligence of the farm labourer. The windlass is compact and portable. A pair of strong wood travelling wheels carry the winding barrels, which revolve on a central axle, and are geared alternately with three driving pinions, by an eccentric movement of the axis, which at the same time brings the slack or paying-out barrel into contact with a friction-roller, instead of the fixed brake-block hitherto used. This operation of paying out the rope is regulated by the double snatch-block fixed before the windlass. A central guide-wheel is mounted on a lever, revolving the two pulleys of the double snatch-block. The slack ropes pass on either side the central guide-wheel, and partly round the two pulleys—motion being given by the taut rope to the guide-wheel on one side, the slack rope is taken off at precisely the same speed on the other side. The operation is thus rendered very similar to that of an endless rope round a single pulley. It is obvious, that as the slack rope is kept in a partial state of tension, there is no difficulty by this arrangement, with the use of the porters, hereafter described, in keeping the rope clear of the ground.

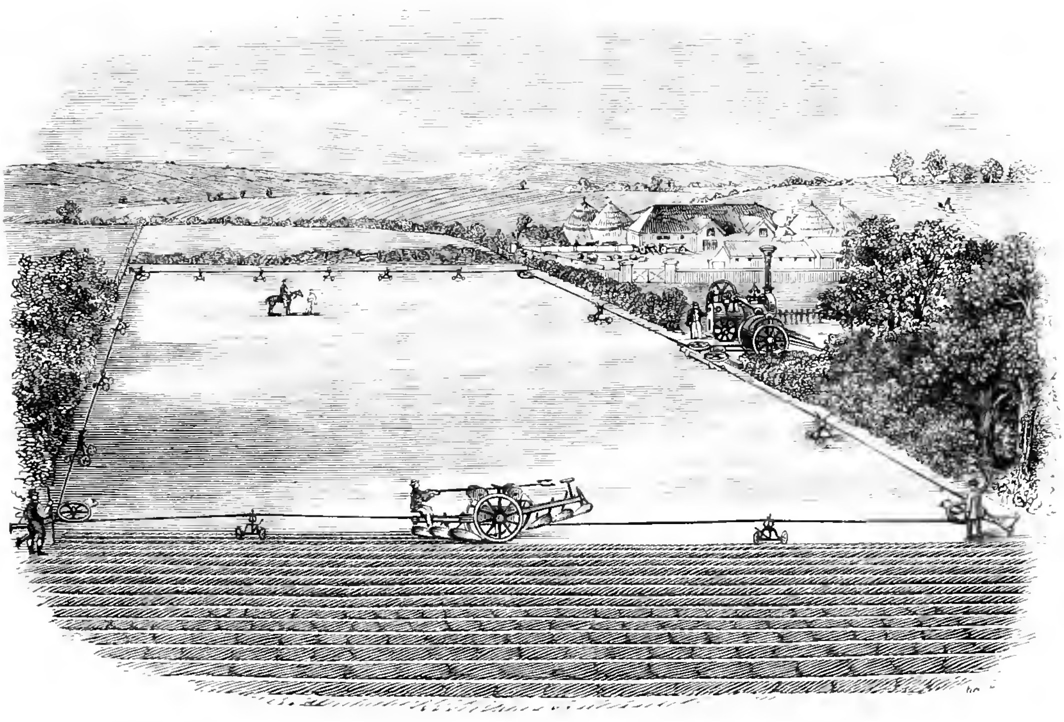
Two kinds of anchorage are used. One is a framework fitted with blades and anchor-pulley, with an automatic movement for advancing on the headlands as the work proceeds, and requires but little attention. The other is a modification of the ship's anchor, with a pulley attached. It is more expensive in labour than the self-propelling anchor, but it has the advantage of being cheaper and portable, and may be worked in almost any position. By its use, the whole of a field, however irregularly shaped, may be ploughed or cultivated without leaving headlands.

The *rope porters*, which are used at intervals along the whole line of the rope, to keep it off the ground, are of a novel description, the pulley which sustains the rope being mounted on a lever, by simply releasing which, the rope clears itself—an operation which was often very difficult to perform with the porters formerly used. The implement used for cultivating or smashing, is a framework of flanged wrought iron, with a pair of travelling wheels, and a seat at either end. It may be worked with three or more tines or shares, according to the nature of the ground and depth of the



FOWLER'S STEAM PLOUGHING APPARATUS AS AT WORK.

In working, the Engine and Anchor move at each bout with the Plough throughout the field.—See p. 608.



HOWARD'S STEAM PLOUGHING APPARATUS AS AT WORK.

In working, the Engine and Windlass are stationary, and the Anchors are moved forward.—See p. 606.

work. The tines work on a centre, and have each two shares, pointing in opposite directions; consequently, the implement does not require to be turned round at the land's end: the ploughman simply changes his seat, and steers in the opposite direction.

The plough, which is made for three or four furrows, may also be used as a cultivator, subsoiler, or ridging plough. It is supported by a framework resting on three wheels, two of which, on one side, are used for steering. When the leading wheel is turned outward, the hinder wheel is turned inward; the third wheel acts as a centre. By this novel arrangement the operation of guiding the plough is rendered very easy. The beam to which the right and left-hand sets of plough bodies are attached are of flanged wrought iron, and intersect each other at their inner ends, thereby reducing the length of the plough. The two sets of beams work on distinct fulcrums, and are suspended by chains from eccentrics, in such a manner that the set of ploughs out of work have little or no tendency to raise the set in work.

The following instructions for using both Smith's and Howard's steam cultivators are usually given to the purchasers of either:—

To the Engine Driver.

1. Do not talk to any one whilst driving.

2. Look very often at the ploughman and anchor men.

3. Slacken speed before the implement gets to the end of the land.

4. In windy and wet weather, when working with a strap, put up one or two poles on each side of it, which will prevent its coming off. Apply Stockholm tar or treacle to the strap in wet weather.

5. In very hard work, when you have an engine with two pulleys on, put the strap on the smaller one.

6. Whenever you can, set down the engine on the highest part of the field.

7. If your engine is a single cylinder, a brake should be used to the fly-wheel.

To the Windlass Man.

1. Put down the permanent anchors about twelve yards before the windlass.

2. Place them at such a distance apart that the rope, when straight, will be exactly in the centre of each drum. If put too near together, or too far from each other, the ropes will not coil properly. Shift the snatch-blocks until the ropes do coil easily, and use the guide roller for coiling the ropes.

3. Do not put the drums into and out of gear while the windlass is in motion.

4. Before the engine starts, pull the rope tight on the drums, and hold it so until the slack is all wound up.

5. Look as often as you can to the ploughman, to see that all is right.

6. Be careful to adjust the pressure on the brakes so as to allow the ropes to run off easily, but without slack, and keep them well oiled. As the brake-block wears, raise it up, by putting a piece of thin leather or wood in the box under it.

7. If an anchor pull up, let out a little slack rope at once.

8. Screw up the bearings occasionally, and keep all well oiled with the best sperm oil.

9. In setting down to large pieces, run your rope *skew* across the field, in the form of a triangle.

10. Take care that the supports on the windlass shafts take a bearing on the ground.

11. The ropes, at the end of each season, and occasionally at other times, should be dressed over with a mixture of tallow and the best Stockholm (not gas) tar.

12. Take the ropes off and turn them occasionally, and see that they do not get twisted. Care should be used to put them on again *tight* and *true*. To this end, when putting on the ropes, let the implement into the ground enough to stretch the rope tight.

To the Anchor Man.

1. Lay your anchor at right angles with the rope, or in such position that the strain is equal on both legs.

2. Place your line under the front, and over the back bar of the anchor, and weigh upon it before the plough starts.

3. When the plough is working away from you, drive your anchor well into the ground, so as to let it get well hold before the strain of the engine comes on it.

4. When you find the engine driver is not stopping the plough in time, knock off the snatch-block ring directly, so as to prevent the plough running into the anchor.

5. Always keep an extra anchor ready, in case of accident.

6. In very loose or wet land, it is sometimes necessary to put a piece of board or wood in front of the anchor, so as to take both tines, or to use two anchors, placing one before the other, and connecting them with an S hook.

To the Ploughman.

1. See that your attendants keep the rope well off the ground with the rollers.

2. Look round the plough at dinner-time and each night, to see that all is tight and in working order. Keep by you some extra washers, linchpins, wheels, and shares.

3. Get off the plough when you come to very hard places.

4. See that all the shares work the same depth. This can be ascertained by measuring from the under side of the frame to the point of the share.

5. See that the wheels are well oiled daily. Also take them off occasionally, and well clean them.

The Howard Steam Cultivator requires six men and two boys to work it; namely, one engine driver, one man at the windlass, one ditto to guide the cultivator, two ditto at the anchors, one ditto at the water-cart, and two boys for miscellaneous work. It is difficult to assess the actual expenses of any of the machines, as some of the reports omit some sources of charge, and some others; but from a general estimate of those who have reported at all on the expense with Howard's machine, the cost per acre may be stated at from 6*s.* 6*d.* to 8*s.* or 9*s.*, according to the state of the land and the nature of the soil.

Fourthly. The class with engines moving along the headlands as the work proceeds, and drawing the implements by means of wire ropes. This is the *direct traction system.*

Mr. John Fowler's apparatus may be considered as the most efficient of this class, and we shall therefore describe it. The machinery consists of a steam-engine bearing its own windlass for giving out and receiving the steel-wire rope. These are placed on the headland at the commencement of a field, of whatever dimensions; and on the opposite headland is stationed another piece of machinery, called an anchor. This is placed on four cutting wheels, for taking hold enough of the soil to withstand the strain of the rope in working. Attached to the anchor is another sheave or windlass, which also receives the rope from that on the other side. The cultivating apparatus, consisting either of four ploughs or a cultivator, as the work to be done requires, is fixed to the rope in the same manner as in Smith's and Howard's systems. The ploughs are placed on a balance machine, and are eight in number, four of them pointing one way, and four the opposite; so that, whilst one set is at work, the other is raised out of the ground, the machine moving on a centre forming an obtuse angle, and running on two wheels. By altering the position of the ploughs on the bevil beam, in either direction, the width of the furrow may be regulated. The anchor and the engine move simultaneously along the headland, as fresh ground is required, and the cultivators are drawn backwards and forwards by the traction rope to and from the engine. The anchor is kept to its work both by its cutting wheels and by a rope running from it and fixed on the headland. Patent slack gear attached to the plough, enables the workman to lengthen or shorten the rope as the irregularity of the field requires. In working, both the tight and the slack rope are kept sufficiently taut to prevent their trailing on the ground. But if the extent of the field requires it, rope porters also are placed at intervals of 40 yards. The windlass on the engine consists of a single sheave, 5 feet in diameter, round which the rope takes *half* a turn. The groove into which the rope passes is formed of a double series of small leaves, which on the least pressure clasp and hold the rope until it takes the straight line on the other side, when the clips open and liberate it. By this simple contrivance all crushing and short bends, which are so detrimental to the profitable use of wire rope, are avoided. This, coupled with the fact that on each passage of the implement the rope is only bent twice, and then only round large diameters, will at once show this system of using wire rope to be most advantageous. The power is conveyed to the windlass by an upright shaft from the crank shaft.

If ordinary steam-engines are used, a patent windlass is provided by Mr. Fowler, consisting of two drums, mounted on a strong horizontal shaft driven by the engine. The rope by which the ploughs are drawn is coiled up on one of these drums alternately, as the implement approaches to or recedes from the windlass, and when drawing is, as a matter of course, always tight and carried off the ground. This windlass is fitted with a self-acting compensating brake, by which the slack rope is kept at a uniform and sufficient tightness, to prevent it dragging on the ground between the rope-porters, and thus absorbing a great deal of power, besides wearing the rope much more than any other cause. The importance of this is shown by the experiments at the Leeds meeting of the Royal Agricultural Society of England, from which it appeared that nearly *ten times the power* is required to draw the rope when trailing ou the ground than is necessary when it is carried off the ground by rope-porters.

The hands required to work this system are three men and three boys, including the water fetching and removal of rope-porters.

Messrs. Coleman, of Chelmsford, have adopted the plan of having two steam-engines and two sets of ploughs at the opposite sides of a field. The ploughs meet in the centre of the field, and then return to their respective engines. By this arrangement the necessity of the large anchor opposite the engine is done away with, the two engines acting in that capacity for each other. Either ploughs, cultivators, grubbers, or subsoil ploughs can be worked by Fowler's apparatus, which requires no more rope than is sufficient to take the implement backward and forward; and it also employs fewer hands. The reduction of animal power, where steam culture is employed, may be estimated at about one-third or two-fifths. Thus, on an arable farm requiring ten horses, three or four may be dispensed with, and the keeping of as many head of cattle substituted.

Thus far, then, the introduction of steam-power in the cultivation of the soil has proved successful, and whichever of the leading systems now at work are considered, we may congratulate the farmer on the importance of the change. We have already expressed our opinion regarding the object at which the machinist should aim in the ultimate application of the new power, and shall not therefore anew enter into the subject and repeat what has been written, but shall rather speak of the advantages accruing from its agency under the present systems, which, however imperfect, afford no doubtful indications of what steam will do for the farmer, when carried out in all its efficiency.

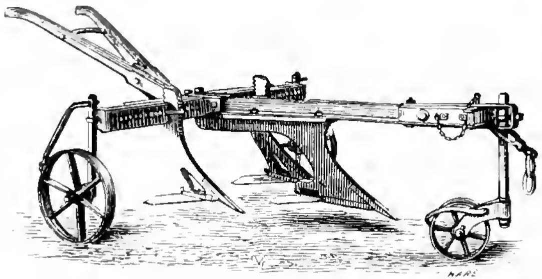
We look upon the saving in money at present, by the adoption of steam as a substitute for horse power, as the smallest advantage that accrues from the change. Two or three shillings per acre on the land annually tilled upon a farm, say of a thousand acres (even if it be *eventually* saved, which we think doubtful), is not so important an object as alone to induce the farmer to make so great a change in his establishment. It is in the *economy of time* and the *efficiency of the work performed* that he looks for the benefits of the present application of steam cultivation.

With respect to the first, the testimonial reports, given by those who have hitherto used the steam-plough in cultivation, are very decided on this point. By its means the clove stubbles can receive a bastard fallow before harvest, which would, in most cases, be impossible under the old system. Yet this i most important preparation for wheat, the seed of which requires a well-pulverised soil in which to strike its first rootlets.

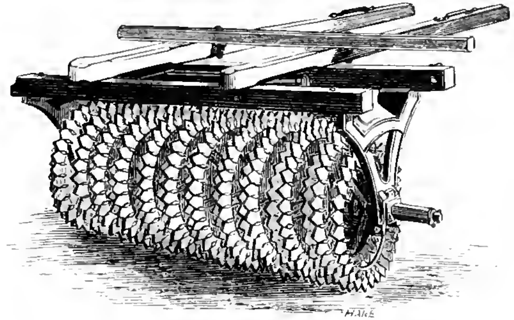
After harvest, the stubbles may be "smashed" up to receive the winter's frost and snow, so necessary to prepare them for the crops that follow; whilst the spring tillage may be got forward even when the ground is wet and poachy, without being trodden upon by horses or men, which sometimes does almost as much harm as the plough will do good. Nearly all the testimonials to different machinists that we have seen and heard, represent this facility of doing the work at the proper time as a distinguishing feature in steam culture; and many of them declare that by its employment they never have any need to be backward in their tillage operations, which previously was the case in most seasons.

Quite as decidedly do they speak of the superiority of the work of the steam-plough or cultivator over that performed by horses. An eight-horse engine will, with ease, do from five to eight acres a day, either with the plough or the cultivator, to the depth of from five to ten inches; and if it is necessary to subsoil, it may be done to the depth of two feet, which never could have been performed by animal power, or by any other previously, except by the spade, which is the most expensive of all modes of tillage. One effect of thus loosening the subsoil with the grubber, is the ease it gives to future cultivation, so that after a few years the steam-plough will be able to do a much greater amount of work, as well as doing it better than at present. One farmer, who has been employing a steam-plough for four years, states, that "the land moves easier every year, and consequently costs less to cultivate." It also enables him, by getting rid of the surface-water speedily, to lay all "the land upon the flat," and to do away with water-furrows, which were formerly necessary to carry off the water after heavy rains or snow.

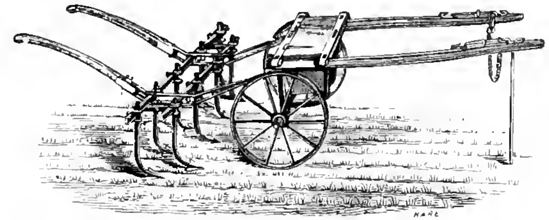
The benefit this improved cultivation imparts to crops of all descriptions is incalculable. We feel convinced that with it an addition of 8 bushels of cereals, and 10 tons of turnips and mangolds per acre, is a moderate estimate of the increase. One writer states that in 1861, with the view of ascertaining the effect of the steam-plough he watched its application on a large farm on which it had been in practical operation for four years. In May he found a vast reserve of mangold, the residue of the winter's consumption of an unusually heavy crop where all the neighbouring farmers had nearly lost theirs. On the same farm he found 240 acres of wheat with not a thin or faulty patch to be seen, and estimated at from five to six quarters per acre, forming a perfect contrast with other crops in the district. And this superiority was ascribable to the "smashing-up system" which had been adopted on the farm. After witnessing these results, the writer, who is himself a considerable farmer, purchased a steam apparatus in June, 1861, and concludes his letter thus in November—"The work of the farm was never so forward as this season, with every prospect of getting my spring corn and roots planted at the earliest desirable period. I therefore feel much confidence in asserting that the cultivator is a most valuable adjunct on any farm of moderate size, whether the soil be light (as some of mine is) or heavy; nor can it be doubted that steam cultivation is the most important discovery of our day, and that it will do more to increase the productiveness of our soils than any of the many improvements which have taken place in agricultural mechanics during the present century."



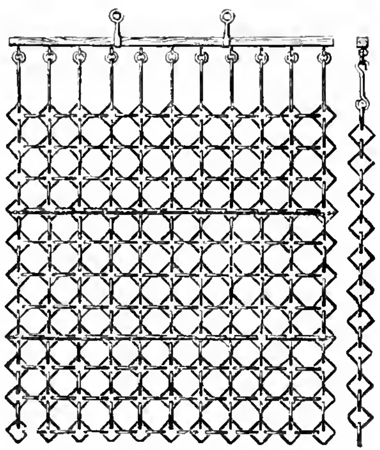
BENTALL'S BROADSHARE.



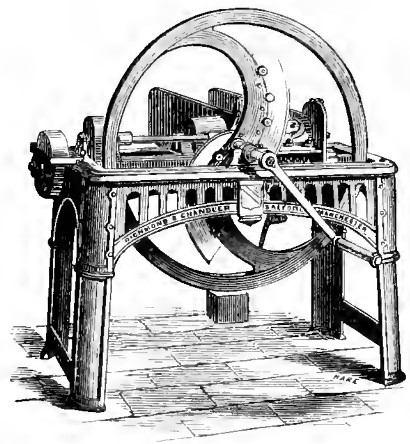
CLOD CRUSHER.



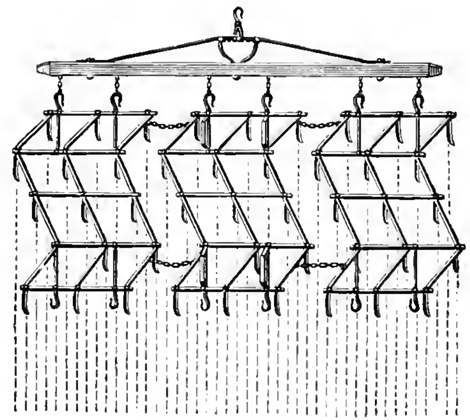
SMITH'S HORSE HOE.



CARTWRIGHT'S CHAIN HARROW.



CHAFF CUTTER.



HOWARD'S HARROW.

SECTION IX.

THE HARROW.

In the present state of cultivation, the harrow is an essential implement in the performance of many operations besides that of covering in the seed. On the principle adopted in the construction of ploughs by the manufacturers, and patronised by the generality of farmers, different kinds of harrows are necessary adjuncts to the plough in the comminution of the soil, which is, by the latter implement, broken up and turned over in a condition most unfavourable to that operation. If the soil is of a tenacious character it requires, after such ploughing, to be first thoroughly dried, and then well moistened by rain, before it can be touched to any good purpose by the *Drag* or *Brake*. Bloomfield, in his "Farmer's Boy," has graphically described the perplexity of the farmer in such case:—

> "Boy, bring the harrows, try how far the rain
> Has soaked the clods!" He comes, but comes in vain:
> Dry dust beneath the bubbling surface lurks,
> And mocks his pains the more, the more he works.
> Still, midst huge clods he plunges on forlorn,
> That laugh his harrows and the shower to scorn."

The harrows employed, therefore, in the various operations of the field may be divided into three classes—the Drag or Brake Harrow, the Common Harrow, and the Light Harrow.

The Brake or Drag Harrow has long been used both in England and Scotland; and, previous to the introduction of the cultivator, or grubber, was essentially necessary for the pulverisation of the soil, especially on rough strong land. It was in fact well suited to the infancy of cultivation; but its use involved a great waste of power, the tines having no, or but little, *cutting* action, by reason of the slowness of the motion of the horses in working it. Consequently, unless under the most favourable states of the weather—first, to dry, and then to moisten and *slake* the clods—the operation of breaking them, if they could be broken at all, was effected by the sheer force of the cattle. Four, and sometimes six horses, or from six to ten oxen, were employed in working this implement, and preparing the land for the common harrow. It is estimated that a cultivator or grubber will produce a far better effect with two horses than the drag will with four or more. The description given by Forsyth of the brake is nearly identical with its present form, except that iron is substituted for wood in the frame. It is as follows:—

"The brake is a large and weighty harrow, the purpose of which is to reduce a stubborn soil, where an ordinary harrow makes no impression. It consists of four square bulls (or bars) each side 5 inches, and $6\frac{1}{2}$ feet in length. The teeth are 17 inches long, bending forwards like a coulter. Four (five) of them are inserted in each bull, fixed above with a screw-nut, having 12 inches free below, with a heel close to the under part of the bull, to prevent it from being pushed back by stones. (He has omitted to mention the five cross bars.) The nut above makes it easy to be taken out for sharpening. This brake requires four horses or four oxen. . . . . It may be applied to great advantage in the following circumstances. In the fallowing strong clay, that requires frequent ploughings, a braking between every ploughing will pulverise the soil, and render the subsequent ploughing more easy. In the month of March or April, when strong ground is ploughed for barley, especially if bound with couch-grass, a cross braking is preferable to a cross ploughing, and is done at half the expense. When the ground is ploughed from a state of nature, and after a competent time is cross ploughed, the brake is applied with great success, immediately after the cross ploughing, to reduce the whole to proper tilth." It will at once be seen that the cultivator is immeasurably superior in all respects to the brake, being adapted to all soils and all states of the land, except in frost, if worked by steam-power, and even with horse-power, if the land can be worked at all.

The Common Harrow has undergone great improvements of late years; but there is a considerable difference of opinion amongst the machinists respecting its action, and it is still undetermined which is the most eligible mode of placing the teeth so as to produce the greatest effect upon the soil. The harrow may be considered an enlargement and extension of the garden rake, this latter having only one row of teeth, set wider or closer according to the state of the mould it is worked upon; and the hand and skill of the gardener are both employed in levelling and pulverising the soil. But the roughness of the surface of the field, and its extent, render it impossible to go over it with such an implement as a rake, or that the hand-skill of the workman can be directly employed in the operation. The harrow, therefore, must be constructed so as to pass most efficiently over every part of the field; and it is still a debateable question how the teeth should be distributed over the surface of the harrow, so as to produce the greatest and best effect.

There are many types of the Common or intermediate harrow between the Brake and the Seed Harrow. The most usual form of the implement consists of a pair of harrows of about 24 square feet in dimensions, which with one man and a pair of horses will go once over 10 acres per day. The form of these harrows is rhomboidal, the draught-chains being fastened to them at the left-hand corner from the driver. Each harrow weighs about 1 cwt., and contains twenty teeth or tines, each of which sustains a weight of about 6 lbs., which is only sufficient to enable it to travel over the surface, and breaks the clods that the plough and the atmospheric influences have left upon it. In addition to this operation, it assists in levelling the field, and removing those inequalities which would otherwise be embarrassing to the subsequent operations of hoeing and mowing. The draught-bar of the common harrow has several holes in it, and by changing the position of the chain on it, the frame will swing to the right or left, altering the line of operation of the tines.

A modification of the rhomboidal harrow has been made by Saunders and Williams, of Bedford. In this, the several parts are arranged in a zigzag form, which enables the frame to act equally on every part of its course across the field. The teeth are passed through a mortise at the point of union of the longitudinal and cross-bars, and are held fast by a screw and nut, which thus serves to hold the whole framework of the harrows together.

Coleman's Harrow deviates widely from the Common Harrow, although designed for the same purpose. It consists of four frames, linked together in such a form that they can be folded up like parallel rulers, each cross-bar being jointed or hinged, so that it can be contracted so as to bring the teeth close together, or expand them to take in a large surface. It is furnished with eighty teeth, which act either as pulverisers or as clod breakers, according as the frame is contracted or extended. The frame is supported by five discs or wheels, which act by a lever and a semicircular bar, pierced with holes. By pressure of the lever down, and fastening it with a pin to the bars, the wheel is pressed down, and secured so far below the frame as to raise the teeth of the harrow quite above the surface, or its action may be modified so as to take greater or less hold of the ground, according to the work required.

The Light Harrow, for levelling the surface, pulverising still further the soil, and covering the seeds, is made in the same form as the common harrow, and differs from it only in dimensions and weight, having generally the same number of bulls or bars, tines, and slots. It is from 33 to 36 inches in breadth, and $3\frac{1}{2}$ feet in length, allowing about 7 inches between the tines, which are from 5 to 6 inches in length. Like the Common Harrow, it may be made either of wood or iron. It is frequently used for collecting the twitch grass on light soils, in which case the horses are generally *trotted* over the surface, giving a zigzag motion to the implement, and shaking more effectually the roots of weeds from the soil. The Light Harrow should always be used in covering seeds, the Common Harrow burying them too deep.

Mr. Smith, of Deanston, invented an Iron Web Harrow for this purpose. It consists of a network of iron wire, $\frac{1}{4}$ inch thick, formed into curves. At every curve the wire passes through the centre of a serrated disc, of the shape and size of a common quoit. The centre of the disc is open enough to give it full play upon the wire when working. The curves or connecting links are 3 inches in length, and $1\frac{1}{2}$ in breadth, and the whole extent of the web is 6 feet by 3. The side and end bars are of 1-inch iron rod, and are screwed together. The discs having full play upon the connecting links, are very effective in tearing and pulverising the surface of the soil, so as to cover the seed, without burying it deeply, with a fine mould, most proper to promote its vegetation. The bush harrow is frequently used on light lands for the same purpose, and has always been found to perform the work effectually. It is also used for spreading and scratching in the manure deposited on pasture land, whether by cattle or for a dressing. It consists of a frame of wood with two strong bars at the ends, and two others in front and rear, making it 7 feet by 3 in dimensions, with a middle bar as strong as the end ones. Bushes are interwoven between the three bars, having their thick ends in front, so that the twig ends pass over the surface and abrade it, so as to cover the seeds, or break in pieces and disperse the manure on the pasture land. It is generally used after dibbing, to fill up the holes.

Messrs. Howard, of Bedford, have constructed several harrows for different kinds of work, and of various dimensions, but all in the zigzag form. For their Iron Drag Harrow they received the first prize at Warwick and Chelmsford. The teeth or tines of this harrow are a clear 12 inches long, and curved towards the point; the frames cover a space of 7 feet in width, and are a good substitute for the old wooden drag harrow. It requires three or four horses to draw it when the ground is rough, which, in fact, is the only condition in which it can be used to advantage. It is, however, made to serve the purpose of a scarifier. The same firm have constructed a set of harrows to be attached to their steam-ploughing apparatus. They are made on the same principle as the horse harrows, and can with ease be worked over from fifteen to twenty acres per day in a superior manner.

The Drill Harrow was first used in the cultivation of potatoes. Its usual form is rectangular, but the cross-bars are semicircular, or arched, in order to adapt them to the form of the ridge or stetch, and the two furrows are connected by coupling-rods at each end, made to contract or expand at pleasure. The draught-chain is fixed to the centre of the front bar, and is united to the swingle-tree to which the horse is yoked. The use of this implement is to level the soil after the plants appear, or at least after the seed has sprouted; and in bean and potato culture it is very useful for that purpose, as well as for loosening the soil. The dimensions of each leaf is 27 inches, and it contains fifteen tines, which allows 1⅞ inch between the drills. The tines are secured to the cross bars by a screw and nut, their length below being 4 inches, and thickness ⅝ths of an inch at the top, tapering to a blunt point. The rise of the curvature of the harrow is from 3 to 5 inches. The coupling-rods are flattened for some inches at each end; they are pierced with three holes, which enables the workman to expand or contract them according to the width of the ridge. The Drill Harrow is drawn by one horse, which walks in the furrow between the ridges.

SECTION X.

THE ROLLER.

Forsyth, who wrote in 1804, says, "The Roller is an instrument of capital use in husbandry, though, till of late years, scarcely known in ordinary practice; and where introduced, it is commonly so slight as to have very little effect."* It is remarkable that such an assertion should be published in a work like the "Encyclopædia Britannica," and republished in a separate work by the same author, when the roller is distinctly referred to by Tull as a common implement for pulverising the soil *"by contusion,"*† and that this was the only legitimate use to which it ought to be put. If used for levelling the ground after the barley or other grain or seed is sown, it ought to be done with a very light roller, and decidedly in dry weather, for if the soil is moist, it binds it too closely, and injures the crop. It is now well understood that, in keeping the soil in a loose state, you are so far *from letting in the drought,* as was formerly supposed, that the land is rendered moister, by the more copious imbibing of the dews from the atmosphere, and drawing the vapours from the subsoil, besides the advantage of encouraging the growth of the plants by enabling their roots to extend themselves.

There are, however, other uses for the roller, which require different kinds of implements; and of late years a great improvement has been made by the substitution

* Forsyth's "Agriculture," vol. i. p. 278. This passage is also found *verbatim* in Lord Kames' "Gentleman Farmer," p. 53; but whether the latter borrowed it from the "Encyclopædia," or Forsyth from him, it is difficult to say.

† See Tull's work, p. 77, ch. vi., "On Tillage," Cobbett's edition. He also, in p. 87, has the following passage:—"Farmers, just when they have brought the land into a condition fit to be further tilled to much greater advantage, leave off, supposing the soil to be fine enough when with the help of the harrows they can cover the seed; and afterwards, *with a roller,* they break the clods, to the end that, if a crop succeeds, they may be able to mow it without being hindered by those clods:" and in a note, he adds, "The injury the roller does is only when it is used to press down the earth after the seed is sown, and is the greater if the land is moist, &c."

of cast-iron instead of wood or stone in their construction. On strong clay soils the roller cannot be used with advantage after ploughing until the furrow-slice has been completely dried, and afterwards moistened by a shower of rain; under the effect of which it slakes like lime, and breaks into powder under the roller. This implement should never, *on any soil,* be used when the land is wet enough for the earth to stick to it.

The roller is required in the spring of the year, after the frost is gone, to press down the soil to the roots of the wheat plant. We have before explained the nature of the root-fall, which attacks that plant at this season, and the importance of attending to it in time to prevent the destruction or injuring of the crop. It should be well rolled some time before the horse or hand hoe is applied, to give time for the plants to strike out fresh roots into the soil, which they will do if the earth is closed around them by the roller.

Both barley and oats, if the soil is dry, should be rolled immediately after the seed is sown, especially if the grass-seeds are sown at the same time. If the soil is moist and tenacious, the operation must be delayed until the condition of the land is such that the clods will break without becoming caked or clung. Grass-seeds are usually sown after the barley or oats are some inches out of the ground, in which case the land should immediately be rolled with a light roller, to pulverise the soil and cover the seeds.

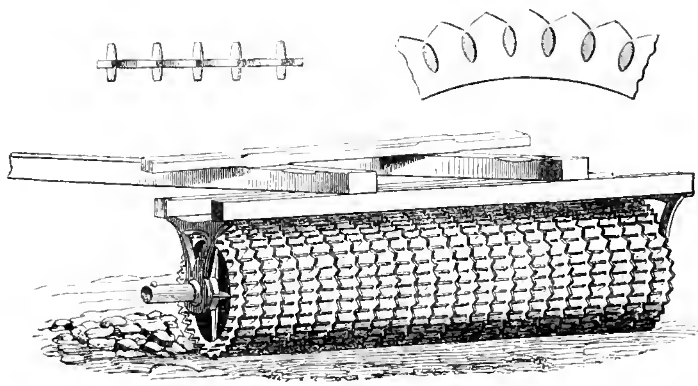
Rollers are of use in reducing fallows to a fine state of pulverisation, and, when the land is foul, to disintegrate it and let loose the roots of twitch grass and other weeds, to be more effectually acted upon by the harrows. With the common roller, 6 feet in length, and drawn by two horses, from fourteen to eighteen acres per day of ten hours may be accomplished. Again, dry weather is necessary for the operation. It is also employed on grass and clover lands in the spring, to level the ground and prepare it for the scythe.

There are various kinds of rollers now in use for performing different operations. The Common Roller is usually a cylinder of wood, and the principal elements to be observed in its construction are *weight* and *diameter,* and these must be proportioned to the nature of the work and the character of the soil. Wood, however, is the least effective material for making rollers generally, on account of its lightness, and the necessity of having it all in one piece, which renders its action in turning at a headland injurious to the young plants in rolling barley or oats. The diameter, too, must be regulated by the size of the timber that can be procured. Oak is the usual timber of which it is composed, and it is not always that it can be procured of the desired diameter, which is from 2 feet to 3 feet 6 inches. This difficulty, with other imperfections, has rendered cast-iron the most eligible material, and we now find that all the manufacturers of agricultural machinery have directed their attention to the construction of the roller on scientific principles, and adapted to every kind of operation. These we shall now describe.

The Common Cast-iron Roller is composed of two cylinders of the equal length of 3 feet, and a diameter of 2 feet, the weight being from ½ a ton to 15 cwt., according to the stoutness of the iron. Many are made of the lighter weight, and are furnished with a box, fitted to the frame of the implement, into which stones may be loaded, to add to the weight according to the requirements of the work. The cylinders are hung on an axle of malleable iron, $2\frac{1}{2}$ inches in diameter, and have at each end of both, an iron cross, fitted with holes in the centre for the shaft to pass. Upon this shaft or axle the two sections of the roller work freely. The frame consists of two semicircular cast-iron ends, with bushes in the under part for receiving the ends of the axle. These ends are strongly clasped to two bars of oak or other hard wood, which are mortised to the shafts to which the horses are attached. The shafts are supported by two iron stay-rods fixed to the ends of the frame.

Some farmers use what is called a Kit-cat Roller for rolling land thrown into narrow stetches. This implement is of wood, the centre being of much greater diameter than the ends; so that, by walking the horse in the furrow, the two ends bear equally upon the half stetches on either side.

The Clod-crusher invented by Crosskill, of Beverley, is a very powerful implement, and well adapted to strong clay soils. It consists of a certain number of cast-iron wheels, according to its length, each of which is supported by a cross, in the centre of which is an eye for the axle to pass. The wheels are all deeply serrated in their circumference, and when fixed on the axle present a very rugged surface. The length is from 5 feet to 6 feet 6 inches, and the diameter 30 inches. The frame is of strong



CROSSKILL'S CLOD-CRUSHER.

pieces of timber, with cast-iron ends, to receive the extremities of the axle, which project beyond the ends of the roller, forming arms, on which wheels are placed to remove the implement from field to field, or to the homestead when the work is done. Each of the wheels of the roller acts separately, and with its angular points splits the clods, reducing them to powder at once. It is also used on light land after it has been sown with barley, in order to consolidate the surface.

A Light Barley Roller has been invented by Messrs. Ransome and Sons, of Ipswich. This is composed of two cylinders of cast-iron, 10 inches in diameter, and 5 feet in length. The frame is of wood, and the cylinders are fixed to it in the same manner as in the foregoing. When this implement is in operation, one cylinder is in advance of the other, the two inner ends crossing an inch or two, so as to go over every part of the land. The two sections are loosely united by a hook and eye, so as to adapt themselves to an uneven surface.

The Presser Roller is used exclusively on light, loose, friable soils, and may be a good substitute for clay, where that material cannot be obtained, to mix with the soil. Varlo says, "the first principle in agriculture is to make a light soil heavier, and a heavy soil lighter." This is best effected by mixing clay or marl with sand or gravel, and *vice versâ*. If this is done effectually with a light soil, the Presser Roller is unnecessary. As, however, it comes in our way, we feel bound to describe it.

The Presser Roller, then, consists of two wheels, 34 inches in diameter and $5\frac{1}{2}$ inches in width, the outside edge or rim being sloped off at an angle of about 70 degrees. They work upon an axle, and are kept separated to the proper distance by iron collars between them. The axle is considerably longer than the space occupied by the working wheels, and at its extremity a common wheel is placed, to maintain the equilibrium. The intention of this implement is to press the furrow-slice of loose sods after the plough, for which purpose they are set at exactly the width to take two furrows, which they press down effectually.

A Press-wheel Roller has been invented by Messrs. Howard, of Bedford, of a different form, consisting of a series of cylindrical wheels, like Crosskill's Clod-crusher, but each of them having a cutting, instead of a serrated edge on the circumference. The roller is made from 6 to 8 feet in length, and from 15 to 26 inches in diameter, and along the whole length an iron bar or rod is fixed, containing scrapers for each separate wheel, to clear it from the adhesion of the soil. This roller is employed for the same purposes as the clod-crusher, and is similar to the one invented by Cambridge, and manufactured by Ball, of Rothwell, Northamptonshire. It is said to be very useful in stopping the ravages of the wireworm and grub on corn lands in the spring.

SECTION XI.

THE HOE.

The operation of hoeing is now almost universally performed by the Horse-hoe, which was first invented by Tull, then almost laid aside for many years; and then, when the drill husbandry came into fashion, was resumed wherever the latter machine was employed in depositing the seed. The Common hand-hoe is an implement too simple and well known to need any description; yet its employment requires no little skill and attention, to avoid doing more harm than good, by cutting up the corn or root-plants with the weeds and supernumeraries that require removing. The Turnip-hoe should not be more than from 8 to 10 inches long in the blade, and it ought to be made of the very best steel, otherwise a good cutting edge cannot be maintained, and the work is difficult to do, without dragging out plants that ought to stand, with those that require to be removed. No one but a practitioner would believe the difference in working between a hoe of good steel and one of iron or bad steel; some workmen will purchase the latter because it is a few pence cheaper, which is very poor economy to the man himself, and still more so to his employer, as he finds to his cost. The Corn Hand-hoe is a much shorter bladed implement, being not more than from 4 to 6 inches, according to the width of the rows of corn. For broadcast corn, a spud is used instead of a hoe, the irregularity of the position of the plants only admitting of the weeds being cut up, without otherwise opening the soil, which is one of the most important operations of the hoe.

The Horse-hoe is usually made to work with one horse, and is entirely of iron, except the shares, which are of cast-steel. They are capable of variation in the setting in the frame, according to the width of the drills, whether of corn or roots. A very efficient implement of this kind is manufactured by William Smith, of Kettering, Northamptonshire. This implement is from 4 feet 6 inches to 6 feet 6 inches long, and will hoe six rows of wheat from 7 to 9 inches apart; three rows of beans, peas, or roots, from 10 to 18 inches apart; or two rows of turnips or mangold-wurzel, from 18 to 27 inches apart, either on the ridge or the flat. It is completely under the guidance of the steerer, independent of the horse; so that it can be worked to the greatest exactness without touching the plants. It is drawn by one horse with ease, having a driver and a boy to lead. The frame of this implement is made of wood, and is as light as is consistent with strength. The hoes are placed on two wrought iron bars, fastened with clips and screws. These are movable, to admit of their being altered to any required width. The axle-trees are movable at both ends, so that either wheel may be expanded or contracted, so as to be always kept between the rows of plants. The bars to which the hoes are attached are fastened to the frame by iron rods fixed to the bars, but movable on the frame, to allow of their being lifted out of the work. The depth of hoeing is regulated by a chain, which can be hooked higher or lower as may be required.

Garrett's Horse-hoe is a more complicated machine, as well as a more heavy one; the following is a description of it:—The main beam or sill which supports the working part of the machine is of wood, and is 7 feet 2 inches in length, and 4 inches in depth. At each end are brackets of cast-iron, which support the axles of the travelling wheels, 4 feet in diameter. A horizontal shaft rises above, and is attached to the sill by brackets, at the ends of which are bearings for the shaft to work. An eccentric wheel is fixed at each end of the shaft with grooved peripheries, in which are chains, fastened at the lower end to the parts of the machine that support the hoes. A lever 2 feet 4 inches long is attached to the shaft, by which the eccentric wheels can be turned to any required extent of their revolutions, and can be kept in any position by means of a ratchet wheel at the left end of the shaft, and attached to the bracket that supports it. At each end of the main sill, and below it, are brackets, at the lower ends of which are jointed swing levers, and these are fixed at the lower ends to a horizontal bar. The levers are employed in carrying the wrought iron coulter-bars, to which the blades or hoes are attached. A spindle is fixed to the centre of the main sill, extending backward, and having at its extremities a suspending lever, with another lever or handle jointed to it, and connected at the other extremity with the left-hand swing lever. A mortise-bar carries the coulter-stalks, which are kept in position by four spring guards, two at each end of the mortise-bar. In heavy clay soils weights are attached to the hoe-guards when the ground is dry and hard.

When at work the hoes must be adjusted to the breadth of the rows, avoiding touching the plants. The hoes are let into their work by releasing the pawl of the ratchet wheel on the horizontal bar, and then allowing the shaft to revolve the required space by the chains in the eccentric wheels, which allows the coulters to fall. The horse should be kept while working as near as possible in a straight line parallel with the rows of plants, but any little deviation may be rectified by the conductor, by using the cross-handles, which give a lateral movement to the bar, the coulter-stalks, and the blades.

This machine, for it is such rather than an implement, covers a large extent of ground, and is so far very efficient; but its weight appears to be too great, and the wheels on a damp soil must sink in and do harm. Our idea is that the horse-hoe cannot be made too light, consistent with strength and power to perform the operation. Whatever weight is added, either by the complication of the machine or its size, must be injurious. The operation of hoeing is so simple in itself, and so easily provided for, that it requires no complications, which only enhance the price without adding to its utility.

SECTION XII.

SOWING MACHINES.

The Broadcast Machine is an invention of the present century, and is ascribed to Mr. Short of Chiverton. In England it is chiefly used in sowing small seeds, the drill husbandry being almost universally practised there. In Scotland it was first introduced by Robert Lowrie, of Edington (Berkshire), who procured one from Mr. Short. This was 8 feet long, and drawn by one man. Lowrie immediately constructed one 15 feet in length, to be drawn by one horse; for which he obtained prizes at the Agricultural Shows of Coldstream and Kelso. The machine soon made its way into East Lothian, and the firm of Scouler and Co., of Heddington, took up the manufacture of it with the greatest success. Various improvements have been effected in the construction, amongst which the addition of a third wheel moving in front as a fore-carriage has added greatly to the steadiness of the machine. The seed-box has also been lengthened to 18 feet, and this is cut into three parts, the middle being 9 feet in length, and the two ends $4\frac{1}{2}$ feet each. These can be folded up so as to admit of the machine passing through the field gates, to do which before it was necessary to turn the seed-box parallel with the shafts. The carriage is made of square beams of hard wood from 4 to 5 inches deep, and $2\frac{1}{2}$ inches thick; the frame is 7 feet wide over the axle, and 4 feet in length over the rails, of which there are three. The main wheels are 2 feet 10 inches in diameter, having wrought iron naves and wooden spokes and fellies, or a hoop of wrought iron $2\frac{1}{2}$ inches wide, by $\frac{3}{8}$ inch thick, the axle being $1\frac{1}{2}$ inch diameter. The left-hand wheel is fixed upon the axle, which revolves round with it, giving motion to the pitch-chain, which regulates the delivery of the seed. The right-hand wheel may either be thus fixed, or run loose on the axle, which consists of two separate pieces. The front wheel is 24 inches in diameter, and is of cast-iron, being supported by cast-iron shares 4 inches wide between the arms; these form an angle with the front beam. The apparatus for delivering the seed from the seed-box consists of a series of wheels connected with one in the seed-box; and different cups are used according to the kind of seed or grain to be sown.

In some parts of England a hand machine is used for sowing grass seed, the only kind which is commonly sown broadcast. It consists of a light square seed-box with compartments in it. The bottom is perforated with holes, over which are pieces of tin, with holes just large enough for a clover or turnip seed to pass through. The box is 12 feet in length, and is hung upon the sower's shoulders by a strap, and every step he takes he gives the box a jerk sideways, which brings the seed over the perforated tin, through which one is delivered with every jerk. By lengthening or shortening his steps the sower can diminish or increase the quantity of seed delivered.

The Corn Drill. The invention of this most useful machine must be ascribed to Jethro Tull, for although Worlidge, who wrote about thirty years before Tull's time, gives both a description and an engraving of such a machine, it does not appear that it was ever practically brought into use; and it is certain that Tull never saw it, although he mentions having heard of it. Whether he took the hint from the engraving or description is a matter that cannot be decided; but we may safely award to him the merit of having first brought into practical husbandry one of the most useful, as it is now the most common, implement, on almost every English farm.

Tull's own account of the invention is very characteristic of the classical turn of his mind. He had, in the first instance, with a view to economise seed, employed persons to form drills in the soil, distributing the seed in them in very small quantities. Ten acres were at first sown in this way at one-fourth part of the expense in labour and seed of the common way; and he was sanguine enough to believe that if ten could be so done, a thousand might also be done as well; but the next year there was a conspiracy amongst his labourers to disappoint him, and never to plant a row tolerably well again. He therefore dismissed his men and gave up the scheme, unless he could contrive an engine to plant more faithfully than such hands would do.

"To that purpose," he says, "I examined and compared all the mechanical ideas that had ever entered my imagination, and at last pitched upon the tongue, groove, and spring in the sound-board of an organ. With these a little altered, and some parts of two other instruments, as foreign to the field as the organ is, added to them, I composed my machine. It was named a drill, because when farmers used to sow their beans and peas into channels or furrows by hand, they called that action 'drilling.' It planted that farm much better than hands could have done, and many hundred acres besides; and thirty years' experience shows that sainfoin thus planted brings better crops, and lasteth longer than sown sainfoin. This drill hath also been used almost as long in planting most sorts of corn for hand-hoeing, and these last nine years for horse-hoeing."*

This passage gives the merit of the invention to Tull, for Worlidge makes no mention of the way in which he caught the idea; and his machine was very simple, and drilled only one or two rows of corn at a time, and we cannot learn from his book that it had ever been used for the purpose; whereas Tull drilled all his crops with his for upwards of thirty years, and always with great success, having commenced using it in 1701; but

* Tull's "Husbandry," Cobbett's edition, p. 452.

although Tull proved the advantages of the drill husbandry in his own practice, he failed in removing the prejudices of his neighbours against what they considered speculative innovations, and very few had the temerity—for in the then state of agriculture such an experiment might be called rash—to adopt the drill. Even so late as the last quarter of the last century the enlightened Dr. Hunter, in the "Georgical Essays," expresses an opinion against the general use of the drill; not because it was not an efficient and useful machine, but because it was so very costly that few farmers would lay out so much money on one implement! What would the learned doctor say now, if he could be set down at any one of our agricultural gatherings, to the vast accumulation and costliness of the machinery that is now becoming as common as "household words" on every farm of moderate extent, and with every farmer of common intelligence? Sir John Sinclair also, at a still later period, strenuously opposed it, and was backed in his prejudices by the *Farmers' Magazine,* a Scotch publication. It would seem that the Scottish farmers have not, even to the present day, overcome their reluctance to abandon the broadcast husbandry,* as is proved by the acceptance the broadcast machine finds amongst them, while in England it is scarcely used at all. There is probably a reason in the condition of the land in Scotland that renders the use of the drill less beneficial than it is in England; but if this is the case, we are not aware of the nature of it. We have met with instances in England of farmers who still adhere to the broadcast husbandry. No longer ago than the present year we went over a farm, and in passing through a field in which the mowing machine was in use, we remarked the extraordinary fine plant of clover over the whole field. "Yes," said the farmer, "I never had anything like it before. The fact is, I *never before used the drill,* but in future I will never sow in any other way."

Perhaps the spread of the drill husbandry was promoted more by the Holkham and Woburn sheepshearings, than by any other circumstance. Both Mr. Coke and the Duke of Bedford were its strenuous and *practical* advocates; and the evidence of its utility on their farms, witnessed annually by hundreds of the most eminent practical farmers in England and from abroad, could not fail to recommend the system. In Mr. Coke's own county,—Norfolk,—the drill was fully established during the first decade of the present century; and Mr. Coke himself declared his opinion, after many years' practice, that the drill husbandry was undoubtedly the most beneficial for all kinds of crops, and in all seasons and countries.

But although the corn drill is a modern invention in Europe, it has, like many other of our modern machines, been known amongst the Hindoos for many ages; for in a series of models of agricultural implements brought from India, and now deposited in the Technological Museum in Edinburgh, is a model of a rudely-constructed drill machine, having all the essential points of our more perfect implements. No date can be assigned to the invention of this model, which no doubt represented a practical instrument, probably in use in India at a period antecedent to British civilisation. The principle of this model is the same as that of our best constructed drills, and it is only in the more complicated and elaborate details of construction that the modern machines excel them.

The invention of the lever corn drill is due, we believe, to a Suffolk machinist,

* This, however, applies only to the corn drill, that for roots and leguminous plants having been in use in Scotland for many years.

the Rev. Mr. Cooke, of that county; and whatever improvements may have been made in it, no alteration has been effected in its most essential principle. It was used by T. W. Cooke, Esq., of Holkham, for many years upon his own farm at the close of the last century, and was highly approved of by him. Perhaps one of the most perfect of the present lever-drills is that constructed by Messrs. Garrett and Son, of Saxmundham, and styled the "Suffolk Lever Corn Drill." This machine is calculated to drill fourteen rows of grain at once, and may be thus described. The seed is deposited in a box, through the length of which a shaft or barrel revolves. On this shaft are fixed a number of wheels or discs, furnished with arms carrying cups at their extremities. As the shaft revolves, these cups take up the seed and drop it into tin tubes, which are connected with the coulter, which is hollow at the back, and as it penetrates the soil the seed is deposited at the same instant. The depth at which the coulter penetrates the soil is regulated by weights hung to the ends of the coulter-levers, and these are jointed at their extremities to a mortise-bar attached to the frame of the machine. By this arrangement the coulters attached to the separate levers adapt themselves to the inequalities of the ground. The distance between the rows is regulated by shifting the levers on the mortise-bar attached to the frame; and to assist the delivery of grain when damp, or rendered adhesive by a lime or other dressing, small hammers are hung loosely over the delivery-cups, which, striking against each cup as it comes over the delivery-spout, the seed is shaken out at once. The coulters can be lifted out of work by turning the barrel round which the chains attached to the coulter-levels are wound. The driving-wheels, which support the machine, have also spur-wheels attached to the naves, and are connected with the pinions keyed on the shaft of the cup-barrel. Wheels of different diameters are provided for the purpose of varying and regulating the quantity of seed as occasion may demand. Two horses are required to work this machine on moderately light land, but on a stiff clay soil more are necessary.

There are now many manufacturers of corn-drills, but all of them are different modifications of the same principle, and are adapted, some for large, and others for small occupations. Some have also been brought out adapted both for sowing grain and root seeds, such as turnips, mangold-wurzel, &c.; but in general the turnip-drill is made specially for depositing root crops, and, in some cases, the manure with the seed. We shall describe one of each of these kinds of drill.

The Turnip Drill used in Scotland is a very simple implement, and is adapted to the Northumberland system of sowing on two-furrow ridges, the manure being previously deposited in the trench, and the earth turned over it by a double-breasted plough. It is called the "East Lothian Drill;" the frame is 4 feet 6 inches in length, and 3 feet across; having two transverse and three longitudinal bars, each $2\frac{3}{4}$ inches square; with three upright bars of the same dimensions mortised into the longitudinal bars of the bed-frame. The latter are further supported with stay-braces attached to them and to the lower part of the upright bars, which add greatly to its strength and steadiness. The shafts for the horse are bolted upon the two transverse bars, and are 3 inches by $2\frac{1}{2}$ inches square; these are also supported by stay-braces, and furnished with the usual horse mountings. Attached to the upright bars below by a shaft or axle, are two rollers of thin cast-iron, 16 inches in length, and 14 inches in diameter at the ends, and from 6 to 8 inches in the middle. The axle, which rests on the two upright bars, passes through the centre of these rollers, which revolve upon it. Two seed-boxes are attached to an iron frame or bow; through the ends of these the axle passes, whereby the whole becomes movable upon the axle. The seed-boxes are 12 inches long, 9 inches wide, and 8 inches high at the apex. The bottom is of tin, funnel-shaped, the end of which hangs within the sheath of the coulter. The depth to which the coulter penetrates is regulated by iron connecting-rods attached to the seed-box frame and to the top of the levers; these latter serve as handles to the machine, and are jointed; when lifted up by the sower, and rested on the iron brackets by which each lever is embraced, the coulter is raised out of the ground by the ascent of the seed-boxes. In working, the rollers form the soil into a smooth semicircle, in the centre of which the seed is deposited directly over the manure.

Messrs. Hornsby and Sons, of Grantham, have constructed a drill on the same principle as regards the rollers, but of a far more complicated make. It will deposit seed either with or without manure, the coulters for the latter being placed *before* the concave rollers, so that the soil, after they have passed, is brought again into the proper form, and the seed deposited over the manure. A light roller follows at the tail of the machine, to smooth the ridges after the coulters. The axles, to which are attached both the seed and the manure-boxes, with the seed-cups and manure-distributors, are worked by series of wheels attached to, and revolving with, the driving-wheels.

The great advantages of the drill-sowing over the broadcast consist not only in the saving of seed, by the regularity of its distribution, but also in the uniformity of depth at which the seed is deposited, and the opportunity it affords for opening the soil to the action of the sun and air, with the horse or hand-hoe. In broadcast sowing, whether the seed is ploughed or harrowed in, a considerable quantity necessarily lies on or near the surface, which may be considered as lost; whilst other portions of it are buried so deep as to be beyond the influence of the promoters of vegetation, and thus lie dormant or perish. Nor can the hoe be effectually applied to corn sown broadcast, the spud, a tool about 2 inches wide, fastened to a long handle, with which the weeds are grubbed up, and the weeding-hook, an arrow-headed tool with one flange, and pointed, being the only implements possible. In this husbandry, however, the farmer trusts more to "a smothering crop" of corn to stifle the weeds than to cutting them up with the spud or hoe.

On the other hand, the spaces left between the rows by the drill, are urged against it, on account of the encouragement they give to the weeds to spring, rendering necessary the hoe to destroy them; and, besides, as the wheat plant throws out its roots horizontally, to the full extent of the space allowed by the drill, the hoers cannot avoid disturbing and cutting off these, whilst rooting out the weeds; and thus the hoe, they say, does as much mischief by weakening the plants, as it does good in opening the soil to the influence of the atmosphere. As those who have urged these objections have never given any facts to substantiate them, nor any estimate of the actual loss of crop sustained by them, and, moreover, not being able ourselves *to prove a negative* in the case, we leave the objection to the reader, to estimate it at what it is worth, which, in the face of so many years' experience, and a widely-extending use of the drill, may be considered to be very little.

Many useful experiments have been instituted to test the comparative advantages of the drill and broadcast husbandry, which have almost universally been decided in favour of the drill. In Scotland, the corn-drill has never been so much used as in England, for which Morton gives two reasons; first, that the scarcity of hand-labour has prevented that systematic cultivation of corn crops in rows, which, in England, owing to a superabundance of labourers, is so efficiently carried out; the hand-labour of the farm in Scotland, which is chiefly performed by women, being in a great measure expended upon the fields intended for potatoes and turnips, and in keeping those crops clean while growing. And, secondly, that the advantages of the drill husbandry are less certain in a moist than in a dry country, and that the climate of Scotland greatly abridges the seed time both in spring and autumn, which renders the more expeditious mode of sowing broadcast necessary, in order to accomplish the work in time. "The long winters and spring frosts contract the spring sowing of oats and barley to six or seven weeks, from the middle of March to the end of April; whilst the raising of the potato crop and turnips, both of which are stored in Scotland, interferes with the wheat sowing in autumn, and allows only a similar period, from the middle of October to the end of November, for its commencement and conclusion." *

Is it, however, correct to say, with the same writer, that the English and Scotch farmer have been striving to reach the same object by different routes—the former by drilling and hoeing his corn crops, and the latter by a system of green-crop husbandry that has made his country an object of admiration to all who have visited it? This implies that the English farmer, whilst using the corn-drill, has neglected his root crops, and that these have not constituted an integral and most essential part of his system of husbandry. Such is the construction that any one ignorant of English farming would put upon this passage in one of the best and most popular modern works on agriculture. The real cause of the superiority of the root crops of Scotland is found in the moisture of the climate, which is favourable to their growth, and not in the more careful cultivation. There are few English farmers who go over the turnip crops with the hoe less than three times; and we could take the reader to farms in which are fields of that root, equal, notwithstanding the difference of soil and climate, to any that Scotland can produce, whether in size, quality, or weight. We have seen, on a shear gravel soil, where size of root cannot be obtained, the bulbs touching each other in the rows, these latter being 18 inches, and the plants 9 inches, apart; whilst scarcely a weed survives the last hoeing. The enormous amount of artificial manure of all kinds bestowed upon the root crops in England, proves the importance attached to them by the farmers; and the care bestowed in keeping them clean from weeds is quite as great as in Scotland. If, therefore, any approximation is to be made in assimilating the practice of the two countries, it must be by the adoption in Scotland of the corn-drill husbandry, which, in fact, is the only material change necessary to that result. But whether that is as well adapted to the Scotch as to the English farm, *all things considered*, is a point on which the Scotch farmer is well able to decide.

Drills are used for planting beans in the furrow after the plough. These are, of course, worked by hand, and consist of a frame on which is a seed-box containing a small barrel, and cups for the delivery of the seed. The barrel is turned by means of an endless chain, which is passed over a wheel attached to the axle of the seed-barrel, and another at the end of the axle of the driving-wheel, works the machine. It is driven before the man like a common wheelbarrow, depositing the seed, at regular intervals,

* Morton's "Cyclopædia of Agriculture," vol. i. p. 720.

in the furrow, to be covered over by the next turn of the plough. The whole of this apparatus is exceedingly simple, but other machines have been constructed to sow three rows of beans at once. These, of course, are more complicated and expensive, but still, much less so than the corn-drill. They are worked by one horse, and deposit the seed in the hollows left in laying the land into two-furrow ridges, which are afterwards split by a double-breasted plough, and the seed thereby covered over.

SECTION XIII.

DIBBLING IMPLEMENTS AND MACHINES.

The practice of dibbling wheat was introduced first into Norfolk about the year 1775, although the dibbling of peas was practised long before. Marshall gives the following account of it in his "Rural Economy of Norfolk," published in 1795 :—

"The practice of dibbling wheat probably arose in this manner. At Deepham, an adjoining parish to (Great) Ellingham, lived one James Stone, a labouring man, who was in that neighbourhood a noted dibbler of peas, and who cultivated for himself a few acres, which he rented with his cottage. He had three children who were as expert at "dropping" as the father was at "dabbling ;" and having some acre or two of clover-ley which came in course for wheat, he conceived the idea of dibbling in the seed, probably thinking that he should thereby keep his children from idleness, and save them at the same time an unexpected supply of bread.

"He accordingly set about putting his scheme in execution, and presently brought his neighbours about him. Some of them smiled and others laughed at his experiment; he nevertheless proceeded with his little crops, and finished his patch. The land being in good condition, and the work being done in a masterly manner, the plants came up so strong and beautiful as to draw the eyes, not only of his fellow-parishioners, but of the whole neighbourhood. Mr. Barnard (who resided at Great Ellingham) well recollects the circumstance, for he passed the close (which lay by the side of a public road) every day in his way to and from school; and says that he has frequently seen the neighbouring farmers in their way to market alight at the gate, and go into the piece to view the crop, which was now become popular.

"At harvest the crop proved extraordinarily good; and the dibbling of wheat has, from that time, been more or less practised in this circle of the county; the only one in which the practice is, even yet, become general among farmers."*

Such was the origin of wheat-dibbling, which is still extensively practised in Norfolk and the adjoining counties, although not so much so as formerly, before the drill-husbandry became popular with the farmers. The following is a description of the tool employed, and of the method of preparing the land and putting in the seed :—

The Dibbling Irons consist of a pair of handles, similar to those of a spade, with a shaft of iron rod ½ an inch in diameter and 2½ feet in length. The lower end of this

* Marshall's "Rural Economy of Norfolk," vol. ii. p. 36, Minute 23.

rod expands out to a conical bulb, rather larger than a pigeon's egg, but pointed at the end and polished quite smooth.

Holding one of these in each hand, the workman walks backward, and bending over the land, strikes them into the flag, making two rows of holes. In withdrawing the dibbles, he gives each of them a twist half round, in order to clear them of any soil that may adhere to them, and also to leave the holes perfectly smooth for the reception of the seed. The rows are usually 4 inches apart, and the distance between the plants in the rows from 2½ to 3 inches, giving from four to five plants in the running foot. The principal tact is in keeping the holes at a regular distance, and in managing the twist or half-circular motion given to the tool, which requires much dexterity and practice. It is also necessary to keep upon the same furrow-slice on which he begins, and upon the *centre* of it, so as to have the seed placed in the thickest part, where there is the most soil. It is usual to roll the land before the dibble, which, added to the treading of his feet in the slow backward movement the dibbler takes, helps to consolidate the soil and facilitate the process.

Every dibbler has three children in attendance upon him to drop the seed into the holes, so that one man and three "droppers" form a set. The dibbler takes three flags or furrow-slices, and he takes first an outside one, and having gone some yards upon it, he returns on the other outside flag of the three, and then finishes his stage by taking the middle one. By this means he keeps his three droppers constantly employed, and, at the same time, is prevented from filling up the holes with his feet before the seed is deposited. If he were to go through one flag in a large field, the droppers would have to pass each other many times to get at the work; but by this arrangement each dropper finishes his or her own flag. Two or three seeds are enough to put into each hole; but the carelessness of children is difficult to guard against, and the best dibblers usually carry a small whip, or a willow wand in their belts, which they make no scruple of using liberally when they detect the children in putting more seeds into the holes than the prescribed quantity. It is wonderful how expert some of the little creatures of five or six years old become under the tuition of a strict dibbler. The danger arises from the child's taking too much into the hand at once. The seed is dropped from between the fore and middle finger, and it requires much practice to perform it properly.

The filling up of the holes after the seed is deposited is done with a bush-harrow, for making which a waggon ladder is sufficiently wide and strong. Between the bars bushes are drawn, with the twig ends all one way, as is described in the section on the harrow. This is drawn twice over the ground, forward and backward, and fills up the holes with the mould it loosens in the operation. A field gate, or a large hurdle, is sometimes used instead of a waggon ladder; but these are too long and heavy, and are apt to tear up the flag where the plough has left it at all rough.

Dibbling is almost always practised, at least in Norfolk, upon the first year's turned up clover-ley, the furrow-slice taken being 10 inches wide. It should be laid as flat and even as possible, and then, being rolled smooth, the dibblers should follow as quickly as possible, to give the seed the benefit of the fresh earth. The manure, whether farm-yard or artificial, is usually laid on and spread before the ploughing; but if the land is already enriched, many farmers consider it unwise to manure at all, except to give the crop a slight top-dressing of condensed manure in the spring.

The saving of seed, if the work is properly performed, amounts to fully one-half, whilst the regularity of the depth observed gives every seed the advantage of a full development of its productive power. The vigorous vegetation which results from the practice prevents the growth of weeds; or, if any should appear, the regularity of width between the rows admits of the free use of the hoe to extirpate them. The consequence of the equal depth at which the seed is deposited is, that the grain ripens all at the same time, and there is little or no under-corn, which is not the case in broadcast sowing. In this respect dibbling and drilling are upon a par, the difference being that the drill deposits a continuous stream of seed, whilst in dibbling the seeds are separated by a space of from $2\frac{1}{2}$ to 3 inches. The greatest difficulty in dibbling is to get the droppers to put only the requisite number of seeds into the holes. We have seen from three to twenty grains deposited; and unless a degree of severity, amounting almost to cruelty, is exercised by the dibbler, and a strict surveillance constantly kept up, the natural heedlessness of children will occasion great injury in this respect.

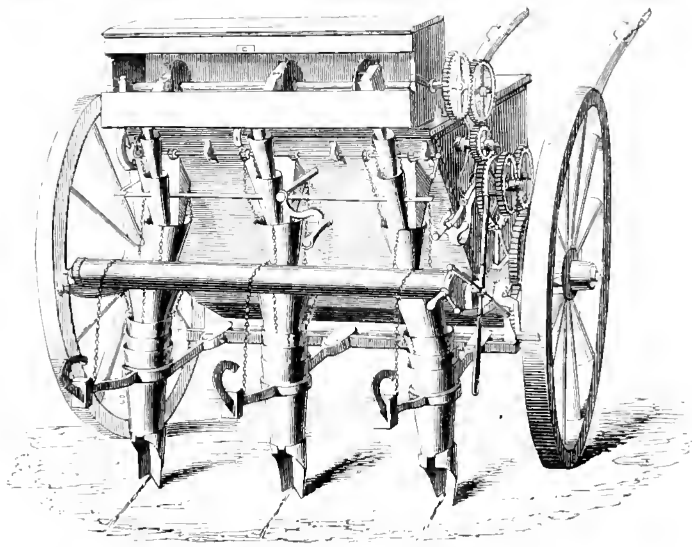
Several attempts have been made to construct machines for performing the operation of wheat-planting on the principle of the Dibbling Iron, the most successful of which are those of Mr. Newberry, of Banbury, and Mr. Newington, of Tunbridge Wells. Newberry's machine is a complicated and expensive one, and the inventor unfortunately expended all his property in bringing it out and rendering it perfect; and although several of his machines were purchased by farmers in Oxfordshire and the adjoining counties, and are still used and approved of, they failed of obtaining that extensive circulation necessary to remunerate the patentee, and have now ceased to be manufactured. It is probable that the price (from £13 for a one-rowed, to £60 for a seven-rowed machine) was the chief obstacle to its obtaining the patronage of the public. The following is a description of this machine:—It consists of one or more hollow flat discs or wheels revolving on an axle or shaft, which rests upon the framework. The disc contains the machinery by which the operations are performed. Eighteen hollow tubes or dibbles project from the periphery of the disc, with which is connected the seed-box above by a pinion on whose axis is the seed-cylinder at the bottom of the seed-box. The pinion is worked by a toothed wheel, and by its action a continuous stream of seed is delivered into an open circular space, along which the hollow dibbling tubes pass, receiving each its share of seed. In the revolutions of the disc, each dibble enters the earth to the depth allowed by its projecting distance from the disc; and in leaving it, a slide is made to open the tube, and the seed drops at once into the hole made by the dibbler. This machine is considered by those who have used it as a very efficient one, the only objection to it being its great weight, which renders from one to three horses necessary for working it, according to the number of discs it contains.

Dr. Newington's is a hand-dibbling machine, and is considered one of the most efficient of the kind yet produced, although very simple in its construction. It consists of from six to nine depositors, connected with a box in front, which contains the seed. The depositors, or dibbles, being forced into the ground by the man who holds the handle, deposit the seed at the depth required, which is regulated by pinching-screws, that keep them in their relative positions. The machine is worked by taking hold of the rail or handle at the top with both hands; and the dibblers, or depositors, being placed on the soil, it is pressed down by setting the foot on a step at the back. The upper handle, which with the depositor form one piece, is then pulled upwards, and as the depositors are withdrawn by the action, the seed is let into the holes by the machinery in the interior of the grain-box. This has a double back, and between the two is a space in which the depositors move up or down, as acted upon by the handle. The seed is delivered to the space between the two backs through holes at the top of the division-plate, two or three at a time, and are thence conveyed by tubes into the holes in the soil. This is effected by short rods with cups attached, which are made to dip into the seed-box and raise the required number of seeds, which, by a reverse action, they bring directly over the holes in the division-plate that are over the holes in the soil. The price of this machine, with six dibbles, is only £2 10*s.*; and as a man can complete an acre in ten hours, and it requires no skilled labour or droppers, like the common hand-dibblers, the expense is not more than one-fourth.

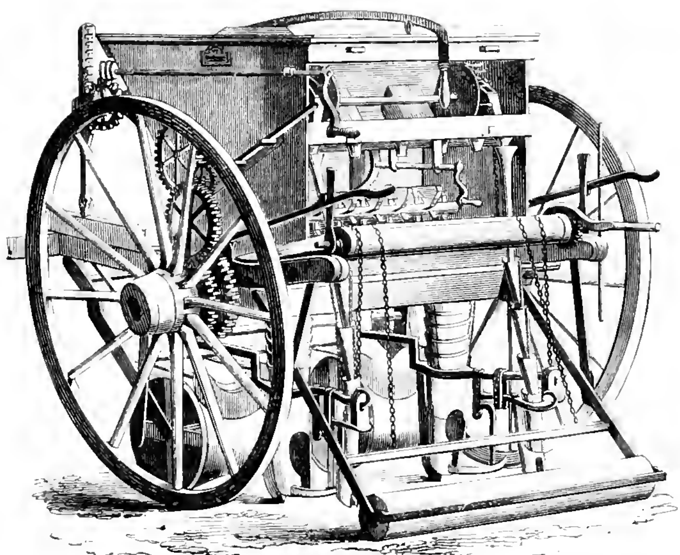
The attempt, however, to imitate the practice of the dibbler with machinery is not absolutely new; for in 1760, Varlo, to whose work on husbandry we have already reverted, invented a machine which, however imperfect, was the forerunner, if not the model, of the recent machines. It consisted of a cylindrical shaft resting on an axis supported by a strong frame. Round this shaft were sixteen flat sides, in each of which were fixed six pins, or dibbles, at 1 foot distance from each other, being ninety-six in all, which, as the shaft revolved, pierced the ground. A seed-box, with suitable apparatus, was suspended over each row of spikes, and the seed was dropped into tubes and conveyed by them into the holes made by the spikes. An engraving of this machine is given in the work, and Varlo states that he himself used it for many years with great success. It does not appear to have been adopted by the public; and, in fact, Varlo gained but little credit for the efforts he made to diffuse the knowledge which he certainly possessed on agricultural subjects. Like most men that are in advance of the age in which they live, he exposed himself to the ridicule of his neighbours by deviating from the beaten track; but, like Tull, he succeeded, and possessed sufficient strength of mind to laugh in return whilst relating the progress and results of his intelligent experiments.

Besides those modern dibbling machines that we have described, there are others possessing considerable merit, and as such have been adopted to a certain extent. Of these the Grain Planter, known as "Sigma's Machine," manufactured by Charles Powell, of Treehurst, in Sussex, is the most simple and ingenious. It is exceedingly similar in its outward form to Dr. Newington's Hand-dibbling Machine, and the mode in which the seed is delivered is also similar; but instead of from six to nine dibblers, Sigma's machine has only five, which deposit five grains into each hole.

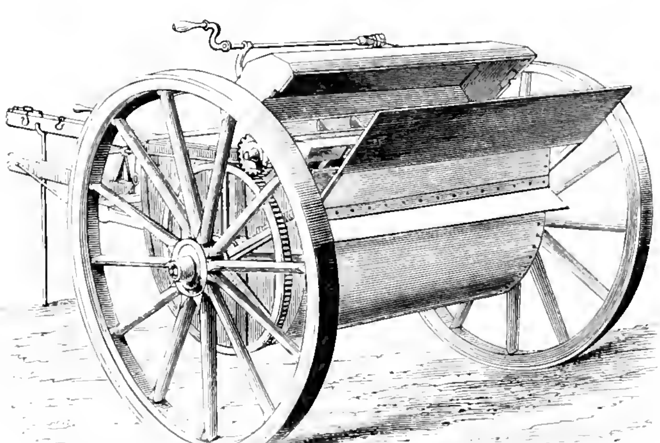
Bentall's Seed-dropper is of still more simple form and make. It is intended to rectify the evils of over-seeding by the carelessness or incompetence of children. It consists of a wooden cylinder, in which is an iron rod, with a handle like that of the Common Dibbler. The lower part of this outer cylinder contains the contrivance for delivering the seed, which is contained in a bag outside, tied round the neck of a child. The lower end of this bag is connected with a spout at the lower part of the dibbler. A horizontal circular flange is placed in the inside of the machine, and covers the exit-hole, having itself ten holes drilled in it, each of which, as the flange revolves, comes in succession over the delivery or exit-hole. This hole is covered with a brush, which, as the flange-holes come round full of seed, sweeps off just the requisite quantity, and no more, into the exit-holes, from which it falls into the hole in the ground. The cost of this implement is not more than 7*s.* or 8*s.*, and it has been found well adapted to the use for which it is intended.



PATENT LIQUID DISTRIBUTOR.



HORNSBY'S TWO-RIDGED DRILL.



CHANDLER'S MANURE DISTRIBUTOR.

SECTION XIV.

LIQUID AND SOLID MANURE DISTRIBUTORS.

The distribution of manure by machinery is a purely modern invention, and has arisen out of the use of condensed artificial manures, whose name is "Legion," and whose application is one of the great agricultural facts of the present day. This subject will be treated on in a separate section; and we shall in this confine ourselves to a description of those machines of most general use for the purpose of distributing the manure evenly upon the ground.

Chandler's Liquid Manure Drill.—Although there are still many farmers who have no faith in liquid manures, because in some instances, and for some undiscovered reason, they have not found them produce the benefit expected from them, yet others, who have applied them to the land for many years, have derived so much benefit from their application, that we cannot doubt that when used in a proper manner and in sufficient quantities, they must be of use to the crops, whether of grass or corn. It is asserted by some persons that *water alone* will do more good on pasture land, than if manure of any kind is steeped in it. This, however, is so contrary to all reason and experience, that it is difficult to imagine how any sensible man can believe it. We can easily conceive that the application of too much water to a dunghill will weaken its fertilising properties; but we cannot be convinced that to add a portion of manure to water will have the same effect upon the latter. It is therefore that we feel justified in describing the Liquid Manure Drill of Mr. Chandler.

This machine consists of a framework of wood 3 inches deep and 2½ inches thick; the driving-wheels are attached to the frame, and are 4 feet in diameter. The manure-box resting on the frame is 2 feet 7 inches in depth, 2 feet 5 inches in length, and 2 feet 8 inches in width. A spur-wheel is attached to the axle of the driving-wheels 12½ inches in diameter, which is joined to another spur-wheel 18 inches diameter, and by a third 10 inches diameter. The first wheel is keyed to the bucket barrel, and the third to the seed-cup barrel, for the machine deposits the seed at the same time with the liquid manure, through the delivery-tubes; and thus united, they drop into the hollow of the coulters, and are deposited in the soil. The coulter-levers are acted upon by a chain passing over the chain-barrel 4 inches diameter, and 3 feet 6 inches long, and it is worked by a cross which is fixed to the shaft. The manure and seed boxes are adjusted on going up or down hill by a lever keyed on the shaft or spindle, at the extremity of which a worm-screw is attached, thus engaging with the worm-wheel, the teeth of which key into the rack of the lever. The bucket barrel is 22 inches in diameter, the shaft of which revolves on the bearings. Buckets 3½ inches long, and 2¾ inches deep, are attached by bolts and screws to the barrel or cylinder; the spur-wheel is keyed into the shaft of the barrel, and, as it revolves amidst the liquid manure which fills the manure boxes, the buckets deliver it to the spout, from which it passes off to the delivery-piping, and finally to the delivery-tins. When the liquid manure is not required to be delivered, the spout is lifted up by a link, the upper end of which is a rack, and is worked by a wheel keyed on to the shaft and worked by a hand lever. It has five distributors.

Another liquid manure cart has been invented by Mr. James, of the Cheltenham Iron Works, which is highly spoken of. It is on the principle of the tank or cistern, but the chief peculiarity of it consists in its containing in the upper part of the tank a strainer, through which the liquid manure flows before it is conveyed to the body of the tank. This divests it of sticks, straws, and other solid matters that would otherwise impede the discharge of manure into the tubes.

Several modifications of the common water-carts used in watering streets and roads have been invented; the principal difference in which is that some adopt the barrel and others the tank for the reservoir. The former is the cheapest and the easiest managed. Either of them, after being set aside for some weeks, as they are at those seasons when not wanted, are sure to get leaky. In such cases, the barrel can be readily staunched by driving the hoops higher up on the outside; but the tank, on the contrary, requires to be taken to pieces, either wholly or partially, in order to close the opened joints. A cask of 120 or 140 gallons is sufficient for the purpose. The distributor is a copper or cast-iron tube made in a curved form, and perforated in its whole length with holes $\frac{1}{8}$ of an inch diameter, and 1 inch asunder. The tube is united to the cask by a hollow arm soldered to it at one end, and firmly fixed to the inside of the cask at the other. A flat weight is fastened by a hinge or strap of leather above the opening of the cask, which, when let down, closes it and stops the discharge of the manure. A chain working on a pulley above, and reaching from thence to the driver of the cart, enables him to let go or to stop the delivery of the manure or the water, as the case may be, for it can be used for either purpose.

A soot-distributor, of an ingenious construction, has been invented by Mr. Main, farming steward to the Marquis of Dalhousie. It consists of a frame mounted on wheels 22 inches diameter, a box 6 feet long and 6 inches diameter, fluted longitudinally and working on the axle of the machine. A chest 6 feet long is appended to the frame, and embraces half the cylinder, and is surmounted with a cylindrical cover. In the interior of the chest is a cylinder of sheet-iron, 22 inches diameter, perforated with holes all over of $\frac{1}{2}$ inch diameter, and the same apart, giving to it the character of a riddle. The cylinder is closed at both sides, and has a trap-door on one side secured at each end with a hook and eye. The machine is put in motion by a wheel fixed to the axle of the bearing-wheels which communicates motion to the wheel on the shaft (18 inches in diameter) of the soot-distributor, by an intermediate wheel. The perforated cylinder, into which the soot is first delivered, screens it from the stones and other substances mixed with it, and delivers it from the fluted cylinder, which is the distributing agent.

THRESHING BY MACHINERY.

SECTION XV.

THE THRESHING MACHINE.

"Thou shalt not muzzle the mouth of the ox that treadeth out the corn." This injunction of the inspired Jewish lawgiver is indicative of the mode of separating the grain from the straw in the earliest ages of the world, and which continues to be the practice in Eastern countries to the present day. Nor is it confined to those semi-civilised peoples, for we find, by the writings of Lavergne, that it is still practised in some of the more secluded districts of France: Arthur Young also stated that it was general in Languedoc, Provence, and other parts of that country, when he visited it in 1789. The method pursued was to form a hard floor of strong clay in the open air; this was inclosed with a ring-fence, and, the corn being laid on it, a number of mules or horses were turned into it. A man was placed in the centre to keep the animals constantly going round the circle. The French farmers, or metayers, preferred this mode of threshing to that by the flail, because it was more expeditious. They are obliged, however, in some cases, when the wheat is wanted for the best bread, to wash it and dry it in the sun before it can be used. Mr. Young says he examined the wheat, and did not find more broken grains in it than in what was threshed with the flail.

It is probable that the moisture of the climate of England caused the flail to be introduced there at a period of history which is too remote to be traced back. This implement, simple as it is, requires to be constructed on mechanical principles, if it is desired to have it most efficient. It consists, first, of an ashen handle 5 feet in length, the end which is held being the largest. At the lesser end is a swivel, generally of bent ash, forming a bow. This is fastened to the helve with leather thongs, the end of the helve being shaved to within an inch and half of the end, so as to leave a projection of half an inch, round which the swivel may play. On one end of the swingel, or beater, another bow of ash is fixed, and this and the swivel are loosely fastened together with a leather thong. The beater should be of equal size throughout, and about 3 feet in length, being shaved perfectly smooth and brought to an obtuse point at the further end. The work of the *tasker*, or thresher, is exceedingly laborious and tedious, and is also the most expensive of the operations of husbandry. If performed by an unprincipled man, the farmer's loss is frequently very great, by having the corn left in the straw. It has been calculated that in many cases as much as ten per cent. is thrown out in this way. It is, therefore, no wonder that attempts should be made to remedy these evils by the invention of machines to supersede the flail.

About the middle of the last century, a Mr. Menzies, of Culterallers, in the upper part of Clydesdale, constructed a machine, to be worked by a water-wheel. The only description we have seen of it states that it consisted of a number of flails; but how they were applied the account does not say. The next attempt was that of Mr. Stirling, of Perthshire, whose machine worked on the principle of the flax-mill. A third attempt was made by one Ilderton, of Alnwick, in Northumberland. This machine acted on the principle of rubbing or pressing out the grain: and a Mr. Oxley, of Flodden, framed one with scutchers. Ilderton's machine, however defective, succeeded thus far, that having been taken to Scotland by Sir Francis Kinloch, of Gilmerton, in 1798, he sent it to Hunston Mill, near Haddington, belonging to Mr. Andrew Meikle, civil engineer, to be tried by the water-wheel of a barley-mill. It was torn in pieces in the first trial, and a larger one met with the same fate. Meikle, however, was an ingenious man, and taking the hint from the unfortunate experiments, he constructed a machine upon an entirely novel principle, and which has ever since constituted the basis of all the machines subsequently invented throughout Europe and America. Thus much is in justice due to the memory of this ingenious man; for whatever improvements have since been made, he was the first who established the principle of threshing by machinery successfully and economically. It is to be regretted that, like too many benefactors to mankind, Meikle derived no advantage from his useful invention, and died, we believe, in very different circumstances from what his ingenuity entitled him to. As a proof of the estimation in which his machine was held in Scotland, Sir John Sinclair states that in 1813, in the Carse of Gowrie alone, a district about fourteen miles long and four miles wide, there were no less than 120 threshing-mills driven by horses, and ten others by water; and that in other parts of Scotland, threshing-mills were so general that it was difficult to find a man to thresh with the flail.*

Meikle's machine consisted "of a revolving cylinder with raised edges, or beaters, placed parallel to its axis, and standing out from its surface. The cylinder was covered with a concave case, or shell, at some two or three inches distance from the surface described by the edges of the revolving beaters. The feeding-board extended radially and horizontally outwards from the cylinder, and, where near it, terminated in two feeding-rollers, which, revolving in and towards each other, not only rapidly drew the straw forward, but held it from going too fast, which, under the action of the beaters, it would have been liable to do. The beaten straw, with the chaff and grain lying loose amongst it, was delivered on the floor behind the cylinder, and the operation of separation by fork, riddle, and fanner were accomplished afterwards by hand. This, with such additions as effect the delivery of the grain, chaff, and straw in separate places, will stand very accurately for a description of the Scotch threshing-machine to this day." † Such was the first successful attempt to perform the operation of threshing by machinery, which has done more towards lightening the most onerous labour of the farm than any other modern innovation.

Meikle's machine was, therefore, simply a threshing-machine, the subsequent operations of separating the grain from the straw and chaff, and otherwise cleaning it, being still performed by hand and the corn screen, as before. But the possibility of threshing by machinery having been demonstrated, there was no question of the plan being improved upon by the great machinists; and they have now arrived at such perfection in the construction of some of the machines, that the corn is not only threshed and separated, but is dressed, put into the sacks, and weighed, ready to be taken to the granary or the mill, according to circumstances.

In Scotland they still adhere to the drum, as invented by Meikle, but in England, it has by some of the makers been dispensed with, and open beaters substituted with equally good effect. Others, however, adhere to the drum, but have improved upon the mode of delivering the sheaf; instead of presenting it radially and horizontally to the beating cylinder, it is inserted in a *tangential* direction, by which the use of the

* Sinclair's "Systems of Husbandry of Scotland, &c.," vol. i. p. 79, note.

† Morton's "Cyclopædia of Agriculture."

feeding-rollers is dispensed with, and the grain is *scutched* from the ear rather than beaten. A slight touch of the beaters is sufficient to produce the effect, and they therefore do not require to project more than half an inch from the cylinder. The velocity with which the cylinder is driven keeps the straw close up to the concave, between which and the beating cylinder, or drum, it passes, and at the same time drives the grain through it.

The following is a description of a portable threshing-machine by Messrs. Garrett and Son, of Saxmundham, Suffolk, who have obtained prizes both for their two-horse and six-horse power machines, at the Lewes meeting of the Royal Agricultural Society. The separated sheaf being passed by the feeder through the opening between the beating and the concave cylinders, is speedily divested of the grain, which falls on to a conducting board from the exit of the concaves, while the threshed straw is thrown into the *straw-box*, on a level with the cylinders; from whence it falls upon *the shaker*, by which any loose grain is shaken out of it, and the straw is delivered over the end of the machine. From the conducting-board the threshed corn falls on a vibrating table, on which also that from the *shakers* is deposited. The whole is passed over a sieve, which separates the bits of straw or ears that are mixed with the grain, and delivers them over the end of the machine. The corn and chaff pass through the sieve into a riddle-box, and finally into a sieve, in which it is winnowed from the chaff and dust. Thus cleansed, it falls into a conducting spout, from whence it is transferred to a box, and is there raised by elevators to a hopper, which, by means of a spout, finally deposits it in the sack. The whole of these operations are performed without the intervention of the hand of man, except in delivering the unthreshed corn to the beaters; and thus, a six-horse power machine will with ease thresh 400 bushels of wheat in the day of ten or twelve hours, at the same time delivering it clean into the sacks.

Messrs. Hornsby and Son have added to their machine an Archimedean screw-tube to receive the grain from the beaters, which regulates the quantity delivered to the sieves, the want of which frequently occasions a great waste by the sieves being overcharged at times, owing to the occasional and unavoidable irregularity with which the machine is supplied with the unthreshed straw. This causes an accumulation of stuff on the riddles, and, at times, a considerable quantity of grain is passed over with the chaff. With the screw, this is impossible, as the divisions of it ensure the delivery to the sieve of a certain quantity, and no more, at every turn. After passing through the screw, it is exposed on the riddle to a strong blast of the winnower, and falls through, divested of the larger chaff, upon a finer sieve, where it is still subject to the blast, both above and below. From thence it passes down into a trough, where the elevators take it up to a spout, which delivers it, in a perfectly clean state, into sacks. If, however, it is barley that is under the process, it will require to pass through the *hummeller* or *aveller*, as it is severally called, by which the grain is divested of the *awns;* and this operation being completed, the grain is delivered into sacks.

The Fixed Threshing Machine is made similar to the Portable, except that it is erected in the barn or some other building of the homestead. In this case the steam-engine is stationed outside, in another building, and a communication with the machine is made through the wall, which also forms a bearing for the fly-wheel and other parts of the machine. The steam-engine of a fixed machine, by being placed centrally in respect to the buildings of the homestead, may be made to perform all the operations of the homestead requiring otherwise hand labour, such as chaff cutting, root cutting, sawing, &c. &c. But as a portable engine is equally applicable to these purposes, and as the convenience of threshing the grain in the field in fine weather causes a great saving of labour in removing the stacks, the Portable Engines and Threshing Machines are almost universally adopted in England. The principal difference now in the various machines of different makers is rather in the care bestowed in the finishing, and the precision with which they perform their work, than in the principle of construction. Minor differences they do exhibit, which give some a preponderance of estimation over others; but all the English makers have now, so far as the law of patents will allow, adopted the improvements and additions that have been made. Almost all are now *Combined Machines;* that is, they perform the various operations of threshing, shaking, riddling, winnowing, screening, dressing, sacking, and even weighing the grain. It may therefore be said that nothing is now required but to economise fuel, which is already reduced, in the quantity consumed, to a low minimum.

In addition to the operations enumerated above, Messrs. Ransome and Sons, of Ipswich, have patented an apparatus for conveying the straw from the threshing machine on to a stack without hand or horse labour. It is attached to the machine at the end of and under the shaker. It consists of an endless net, revolving at each end upon rollers turned by the steam-engine, and it will deliver the straw to the distance of 60 feet from the shaker, and to the height of 27 feet. The stack may stand at any point within an angle of 45 degrees right or left of the machine.

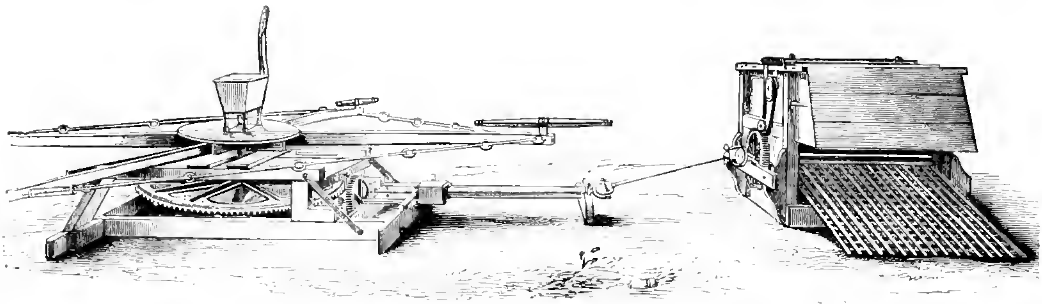
SECTION XVI.

HARVESTING IMPLEMENTS AND MACHINERY.

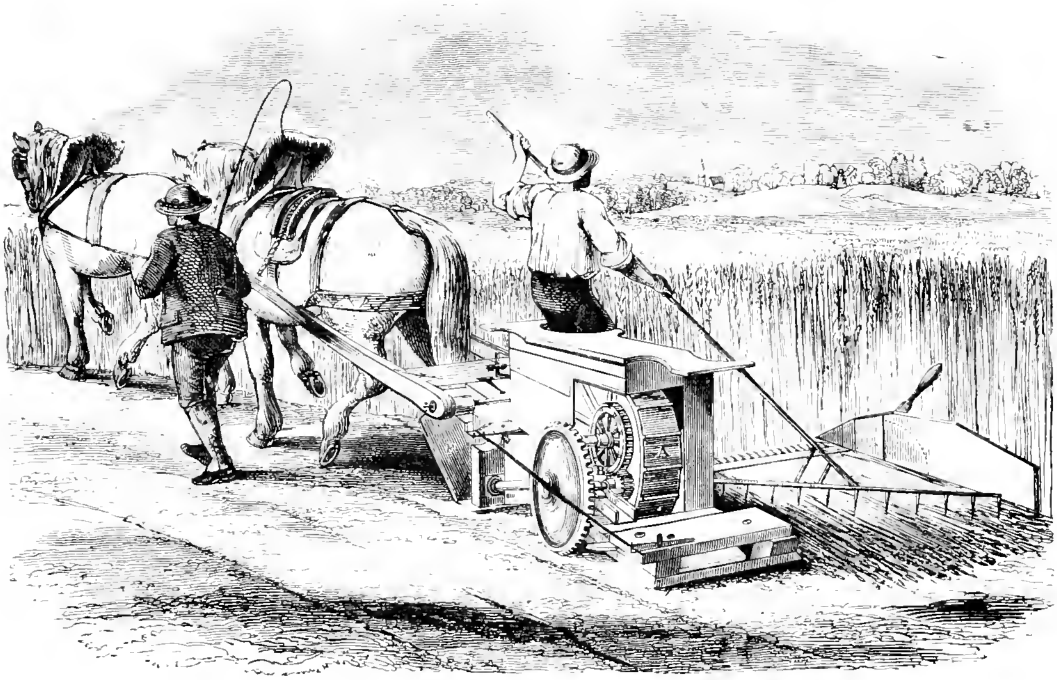
THIS section includes the Scythe, the Sickle, the Reaping Hook, the Reaping Machine, and the Mowing Machine.

1. *The Scythe.*—This is perhaps one of the oldest implements of husbandry in Britain, and it is impossible to discover the etymology of the word. Its orthographical affinity to the Scythians might lead to the supposition that we had learned its use from that nation;* but the fact that the Scythians did not practise husbandry, but lived a nomad and pastoral life, existing almost entirely on animal food, is against that supposition. Be this as it may, at the period of the Roman conquest the scythe was not only employed in agriculture by the Britons, but also as a weapon of warfare, being attached to the axles of their war chariots, with which they drove furiously in amongst the hosts of their enemies, committing terrible havoc. The scythe, however, as an implement of husbandry, has had its day, and, with the flail and many other ancient tools, is being superseded by more economical and expeditious aids to the labour of the farm. Its construction varies considerably in different countries, and even in different

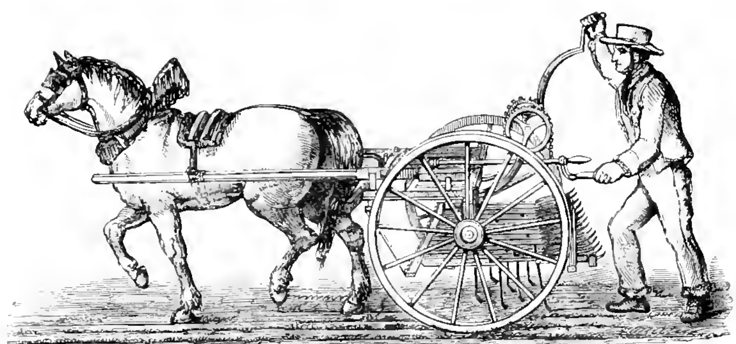
* The first race of Scythian kings, or chiefs, were called *Scythes.*



GARRETT'S THRESHING MACHINE AND HORSE GEAR.



GARRETT'S REAPING MACHINE.



HORSE HOE.

parts of the same country. Whilst in the eastern and northern counties of England scythes with a long blade are in use, cutting a swath of from 4 to 5 feet in breadth, in the south of England a shorter and less curved blade is preferred. In Cheshire the Hodding Scythe is in use, having a blade of 20 inches length, and bent so as to form a bow. It is employed in cutting out the roots of rushes and other coarse plants in meadows and pastures.

The edge of the scythe should be raised relatively a little above the back, to prevent its acting too close to the ground. The point must be curved from the back to the edge. The art of using the implement correctly, so as to avoid either striking the point into the ground, or leaving at the heel and toe of the swath a high stubble, consists in keeping the heel of the scythe down, and driving the whole blade through the corn or grass with a level curved sweep from its entrance to its exit. From want of attention to this rule, or with a desire to get through as much work as possible, we have frequently seen from 5 to 10 per cent. of the grass or straw left in stubble on each side of the swath after the hay or corn has been removed. The mowing machine, however, is affording a remedy for this evil.

2. *The Sickle and Reaping Hook.*—We place these together, because they are the same in form and use, and only differ in the sickle having a serrated edge and a narrower blade than the hook. The latter is also usually rather longer than the sickle. Both are made with a sharp curvature of the blade near the handle, whilst the rest of it forms an expanding arch to the point, which is rounded off from the back. In using either the sickle or the reaping-hook, the tool being held firmly in the right hand, is thrust in back foremost, and turned level, so as to cover a sufficient quantity of the straw. By a sleight of the right hand, assisted by the left, the straw is collected in the sharp curvature of the heel of the implement, when, being grasped in the left hand just above the edge, the sickle is drawn from heel to point, and the whole of the handful is cut. Beginners in this operation are very apt to inflict severe gashes on their hands or fingers, for want of tact in drawing the implement through the straw. The chief art lies in collecting the straw in the curve, and in holding the implement at the right angle with the hand, so as to cut the portion of the straw in the most expeditious manner. Both mowing and reaping are the most onerous parts of husbandry work, and the farm labourer has no reason whatever to complain of the introduction of machinery into this department of rural economy.

3. *The Reaping Machine.*—This is decidedly a modern invention, dating no further back than the close of the last or the beginning of the present century. It is unnecessary to describe the different modes of application adopted, and which successively failed, previously to the year 1826, when Bell brought out the first machine that proved effective. At the same time, it would be unfair to omit mention of those who were the pioneers in the work of invention, and who risked their property and their reputation as mechanics in the cause.

The first of these was Boyce, who at an early period of the present century patented a reaping machine, which had a revolving apparatus, furnished with short scythes, which mowed the corn as the machine proceeded. But not being provided with the means of collecting it when cut, it did not succeed. This was followed by Plunket's Reaper, in which a circular *serrated* cutter was substituted for the short scythes. Like the former, it failed in not having a gathering apparatus. Gladstone's Reaping

Machine came next. This had a circular revolving cutter, with a smooth edge, fixed to a carriage frame with two wheels. The shafts for the horses were on one side, so that the animals walked by the side of the standing corn, as is the case with most of the machines now in use. An apparatus was provided for gathering and holding the corn until cut, when, by another contrivance, it was delivered in handfuls. The machine was furnished with the means of sharpening the cutting-edge without stopping the work. But the imperfect working of the collecting-apparatus occasioned so much after-work, that the machine failed of meeting the approbation of the public, and it was laid aside.

Salmon's, Scott's, Ogle and Brown's, and Kerr's machines followed in quick succession; and although some, or perhaps *all*, of these approached nearer and nearer to general utility in their mode of working, they each exhibited some defect that prevented them from obtaining the patronage of the agriculturists. In 1812, Mr. Smith, of Deanston, brought out his reaping machine, which for a time bade fair to obtain the public favour, to which the well-known character of the inventor as a mechanic, as well as an agriculturist, was calculated to contribute. The cutter was on the circular principle, and was 5½ feet in diameter, and it consisted of thin steel knives bolted to an iron ring. The gearing for moving this apparatus was regulated so as to cause the edge of the cutter to advance nine inches to every inch of the progress of the machine. The horses were yoked to a pole behind the machine, so that they pushed it before instead of drawing it after them. A drum surmounting the cutter, and revolving with it, carried the cut corn round until it fell off on one side in a regular swath. The machine was 7½ feet in length and 3 feet in width, and its weight was so great as to render it unmanageable. This, and a defect in the placing of the bearing-wheel under the centre of the cutter, so that when the wheel came into a furrow it drove the cutter into the ground at the side of the ridge, proved fatal to its success, although, so far as cutting the corn, nothing could be more perfect.

The next in point of improvement was Mann's Reaping Machine, still on the revolving principle, but adopting the polygonal form for the cutter instead of the circular, and having twelve equal sides. By this means, instead of a continuous cutting, as was the case with Smith's machine, the cutter acted by a succession of strokes upon the corn at the angles of the polygon. The cutter was 4½ feet in diameter, and made 175 revolutions per minute. It is unnecessary to give a detailed description of this machine, which, like all the others we have enumerated, was never employed throughout a single harvest, although it had trials on various occasions. This was the case even with Smith's machine, which, from the year 1812 to 1835, was brought forward, with various improvements, from time to time at great trouble and expense; so true is it that one single defect in the principle of a machine is sufficient to condemn it in the estimation of the public.

The next in order of invention, and the first in point of general utility and correctness of principle, is Bell's Reaping Machine. The inventor, who we believe is still living, is a clergyman of the Scottish Church, and minister of the parish of Carmylie, in Forfarshire. This machine was first brought out in 1826, and when completed, was introduced to the notice of the Highland and Agricultural Society, which appointed a committee to inspect and report upon its operations in the field. Their account was so favourable, that the Society awarded the inventor the sum of £50, and had a working model of it placed in their museum. The principle on which the cutting apparatus was based, was that of clipping by a series of shears, which alternately cut with either edge, so that their points were always open to receive the standing corn between the blades, cutting it right and left by the see-saw movement of the bar to which the shears were fixed. There were thirteen of these *fixed*, and twelve moveable ones, the bar to which these latter were attached being shifted alternately to the right and left, far enough to bring the blades in contact with the edges of the fixed ones, and thus cutting everything that came in their way. The cutting-bar was moved by a lever turning on a fulcrum in its centre to the right or left, by means of a roller with an eccentric fin at the other end. The reaping or cutting apparatus rests upon three small wheels or rollers to keep it at the proper distance from the ground. The eccentric fin moves between two small rollers at the end of the lever; and by its eccentric action gives rapid right and left motion to the lever.

When cut, the corn is placed by the reel which gathers it to the shears upon an endless web, which throws it off on the side from the standing corn. The apparatus is supported by a rectangular frame, and the machinery receives its motion from the gearing attached to the running-wheels. The horses are placed behind the machine, and consequently push it forward against the standing corn, instead of drawing it on one side, as is the case with many of the more recently constructed machines. The wheels are put out of gear in going to, or coming from, the scene of labour. The reel which gathers the corn to the reaper is acted on by a band and pulley. It has six arms the length of the cutting-bar, and its motion is so regulated as to present the corn to the shears with the greatest regularity, and in just sufficient quantity for them to cut it with ease. The endless web, which receives the cut corn, is moved by two rollers, one at each side of the machine, and connected with the gearing of the machine by bevel-wheels fixed to one of them, the other being quite free. The web can be moved to either side, according to the side on which the machine is to operate on the standing corn. The rollers may be covered with india-rubber in order to prevent the cloth from slipping, which it would be apt to do if the wood or iron of the rollers was left bare.

Four of the original machines made by Mr. Bell were taken to America, and, in all probability, became the models from which the machinists of that country afterwards constructed their own. In the cutting-apparatus especially, if they have *improved*, they have not *altered* the principle; yet they claim a priority of invention, and repudiate the idea of having copied from any one. It is natural enough that America should take the lead in machinery, the scarcity of hand-labour rendering it of the first importance to find substitutes for it. But that the reaping-machine was an original invention of the machinists of that country is disproved by the fact that previous to Bell's reaper being brought out, nothing of the kind had appeared in America; and that soon after the four of Bell's had been sent there, six reapers, constructed by as many different machinists, were exhibited at the fair at New York, each party claiming a priority and originality of invention, yet all of them working on the same principle as that of Bell's machine, especially in the cutting-shears. They generally differ in having the cutting-bar at the side, the horses drawing instead of pushing the frame. That this is an improvement may justly be doubted; and from what we have seen of the working of the two systems, we think it a question whether that of Mr. Bell will not ultimately prevail over every other.

An improvement on Bell's reaper has been made by the trustees of Croskill, the performance of which we had the opportunity of witnessing during the late harvest (of 1862). This machine has a cutting-bar 8 feet in length, and it is driven forward by three horses. It delivers the corn either on the right or left hand, requires no scythe to prepare a passage for it in the first instance, can work through the middle of a field of standing corn, and will finish in the first style of work from 25 to 30 acres in twelve hours.* There is but little difference, except in size, between this machine and Bell's original one, save that the modern cutting instruments were substituted for the shears.

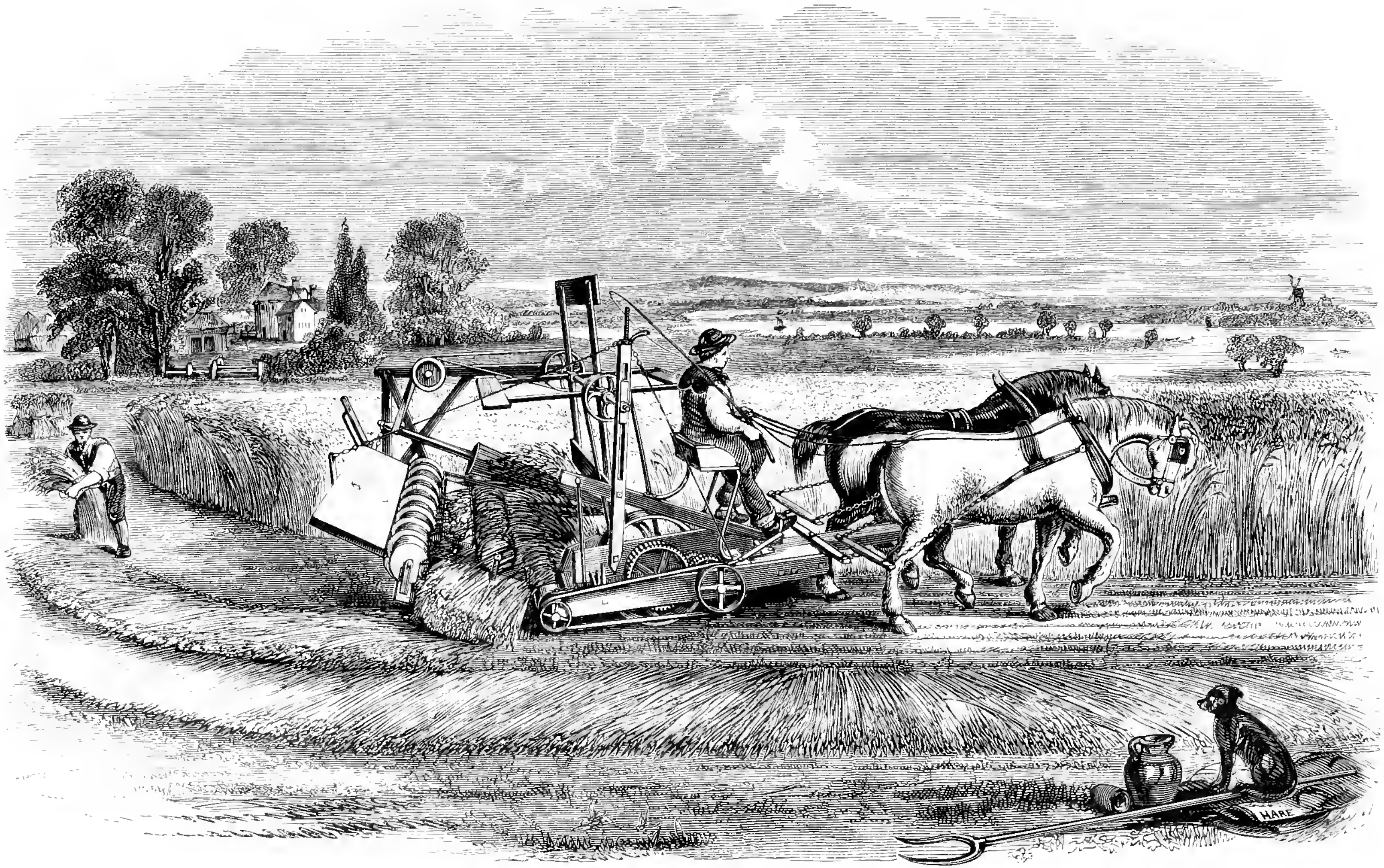
Of the superiority of the right-forward instead of the side-long operation of the cutting-bar, there are doubtless different opinions; yet the question may be decided upon mechanical principles. It would require much greater effort to drive a barrow or any other small hand-vehicle with the arm extended *sideways* than it does to push it before you. It is true, in this case it is the machine that is extended sideways, while the horses draw straight forward. Notwithstanding this, the draught must be increased in proportion as the area of working beyond the centre of power is extended on one side or the other. The delivery-web is considered to increase greatly the friction in Bell's machine; but this has been improved by Mr. Croskill, by the substitution of gutta-percha bands, which perform the work quite as well, whilst they diminish the draught. The machine which we saw at work appeared to occasion no distress to the horses, who walked through a stout field of barley, in which the clover was a foot high, with the greatest ease, and without sweating a hair.

Of the machines introduced by American machinists, the McCormick's and the Hussey's are the most noted; and, as these embrace all the most valuable points of the rest, we shall describe them, premising that both are evidently modifications of Bell's.

McCormick's Reaper, as improved by Messrs. Burgess and Key, of Newgate Street, London, differs from Bell's in having the side-long cutting-bar: it is furnished with cutters having a serrated edge like that of a sickle, and the fingers or fixed points in contact with which the corn is brought as the machine progresses, serve to collect the corn, which is brought to them by the reel, and held by it to the cutting-blades. The great improvement effected by Messrs. Burgess and Key is that for the delivery of the corn to the ground after it is cut. Instead of having a man on the platform with a rake, they have substituted Archimedean screws, upon which the corn falls after being separated, and is delivered by them on to the ground by the side of the machine, in a regular swath, without any further trouble. The height that the machine works from the ground is regulated by the driver shifting his seat, which is hung upon a balance connected with the cutting-bar gearing. By moving right or left, he can elevate or lower the cutting-bar at pleasure, as required.

Hussey's machine is manufactured by Messrs. Dray and Co., of Swan Lane, London Bridge. Like McCormick's, it is a modification of Bell's machine, but is destitute of the reel for gathering the corn to the reaper, and therefore requires a man with a rake, to collect it into form and deliver it to the ground at the side of the machine. The frame for containing the gearing apparatus is supported by a travelling-wheel 2 feet 8 inches in diameter, and furnished with a number of ribs across its periphery half an inch deep, which enables the machine to take a more firm hold of the ground when at work or on the road. A spur-wheel 18 inches in diameter is attached to one of the

* We reached the farm on which this machine was at work about twelve o'clock, and found in the barn a waggon loaded with sacks containing barley which had been cut the previous afternoon, and was then ready to be sent to the maltster.



BURGESS AND KEY'S AMERICAN REAPER.

arms of the driving-wheel, which works a shaft by the medium of a pinion. A large bevel-wheel is attached to this shaft, which engages with a pinion keyed on the end of the crank-shaft, to the pin of which one end of the connecting-rod is jointed, whilst at the other end is joined the bar that carries the cutting-blades. The height at which the cutters work is regulated by two wheels, one of which is connected with the frame on the opposite side from the driving-wheel, the other being attached to the pole in front. By pressing on a handle of a curved *guide* connected with the first wheel at its angle, and with the cutting-bar at the other end, the centre is brought nearer to the ground, and the cutting-bar raised more above it. The two wheels are so adjusted as to keep the bar on the same level throughout its extent, and can be raised to any height within the range of 2 and 8 inches.

The cutting-bar is 7 feet in extreme length, ¼ inch thick, and 1 inch broad, the end next the connecting-rod being strengthened by an additional plate 1½ inch broad and ¼ inch thick, and extending along the bar 1 foot 8½ inches, and within about 1½ inch of the first of the cutting-blades. These are of hardened steel, and are fastened to the bar by two rivets in each. There are twenty-one blades, and a half blade at each end. The length of the blades is 4½ inches, the breadth at the base when fixed to the bar, 3 inches. The point is rounded off to ⅜ths of an inch. A lozenge-shaped aperture, 2½ inches in length, is cut in the centre of each blade, which prevents it from choking, when at work, in the slot of the fingers. The blades are bevel-edged on the upper side, to form the cutting edges.

The finger-bar is of wrought iron, 3 inches broad and 1½ inch thick, and it is placed in front of the cutting-bar. The extreme length of each finger is 9½ inches. A slot ¼ inch in depth is cut in each finger for the blades to work in and out. The fingers are of the shape of a broad-bladed knife, the edge downwards, and the slot cut so that the cutting-knives can work backwards and forwards in them clear of the finger-bar.

The benefits resulting to husbandry from the invention of the reaping machine are incalculable. In a pecuniary point of view, the economy is very considerable as compared with the expense of reaping by hand. The following statement of the actual cost of hand and machine labour is taken from Mr. Morton's work:—

Hand Labour.

Reaping, tying, and stooking . .	from 10*s.* to 12*s.*	per acre.
Mowing, tying, raking, and stooking	„ 7*s.* to 9*s.*	ditto.

Machine Work.

	s.	*d.*
Two men at 5*s.* each per day . . .	10	0
One boy 1*s.* 6*d.* Oil 4*d.*	1	10
Food for two horses	4	0
For cutting ten acres	15	10
Or per acre cutting	1	7
Tying, stooking, and raking	3	6
Total cost per acre by machine	5	1

So that upon a farm where there are 100 acres of wheat, the saving in one season, in labour alone, will amount to upwards of £50, even with so moderate a quantity cut in the day as ten acres, which is the minimum. But even this saving is small compared with that of the despatch with which the harvest may be gathered in, if advantage is taken of fine weather when the corn is ripe—and the economy of time at the most critical season of the year. How often has the farmer vainly sought, at great additional expense, for more labourers, when a few hot days have ripened the wheat all at once, and it begins to shed the grain? The process of reaping with the sickle, or reaping hook, is tedious as well as expensive; and the farmer is well aware that he cannot hasten it beyond a certain point. In a fickle time, therefore, he has hitherto been condemned to see his crops injured, and the period of harvest protracted indefinitely, without a possibility of being able to remedy the evil.

So far as natural causes will admit, the reaping machine has, to a great extent, supplied the remedy. Not only is the harvest now concluded by its help at a much smaller expense, but the processes are so much hastened, that instances have occurred in which the crops of a large farm have been gathered within a fortnight, whilst the neighbouring farmers, on the old system, have had it protracted to five or six weeks. Nor is it less beneficial in affording the opportunity of preparing the land for wheat sowing and other autumnal work at an early period of the season. Every intelligent farmer understands the importance of this, and the loss sustained by having to put off either the wheat-sowing or the breaking up of the stubbles till the spring. In the one case, the produce is almost certain to be much less; and in the other the land loses the benefit of the winter's frost and snow, and of that ameliorating influence which the admission of the air into the soil is well known to exercise.

SECTION XVII.

THE MOWING MACHINE.

The Americans claim this machine as their own, to the exclusion of all other nations; and so far as the application of the machine is concerned, they are correct. But here again the principle is Bell's, being identical with that of his reaper, with such modifications as the different nature of the work requires. The English machinists now, indeed, combine the two operations in the same machine, only changing the cutting-bar and knives, which for mowing grass require to be shorter and stronger, and the action quicker, taking less at a stroke than in reaping. The mowing machine brought out by Messrs. Burgess and Key is simple in its construction, and very efficient in operation, and is, perhaps, one of the best specimens of the class amongst the numerous ones that have been presented to public competition. Wood's also, brought out by Messrs. Smith and Ashby, of Stamford, has been much approved, cutting from 10 to 15 acres per day. Both these are combined machines, and have severally received prizes at different agricultural meetings for both reaping and mowing.

SECTION XVIII.

THE HAY-TEDDING MACHINE.

This is a newly-invented machine, and is getting into general use in England in the harvesting of the crops of meadow or upland hay, for which it is peculiarly adapted. It consists of a light skeleton frame, or carriage, composed of a transverse bar in front, 6 feet in length, into which the shafts for the horses are strongly mortised. An iron stay on each side, fastened to the shafts and attached firmly to the end of the bar, support the shafts, and are continued from the bar to the box which carries the axle of the running, or carriage-wheel, on each side. The length of these stays is 3 feet 10 inches, the breadth 2½ inches, and the thickness ½ inch. The carriage-wheels are 3 feet 10 inches diameter. They revolve on axles cast on a circular box, into which the nave of the wheel, bearing a ratchet, is received. This ratchet-wheel moves the spur-wheel, and carries it round when the machine proceeds forward; but instantly gets out of gear on backing or turning. The spur-wheel works into a pinion on the end of a hollow shaft, which reaches from side to side of the machine. Both spur-wheel and pinion are closely boxed up in a cast-iron case, to prevent any hay getting entangled in the gearing. A connecting bar of 1½ inch rod-iron passes through the hollow shaft, fitted tightly at the end into the outward side of the case that contains the pinion, and fixed with a screw-nut on the outside of the case; and the hollow shaft and pinions being firmly connected by flanges, they revolve round the central rod, or shaft, as one body, the rod having turned bearings where the pinion embraces it. Two wheels of light construction are attached to the hollow shaft, armed with eight rakes fixed at equal distances on their circumference. These consist of wooden bars 5 feet 6 inches long and 2½ inches square, each being furnished with ten light iron prongs 7 inches in length. The rakes are attached to the wheels by a tumbling-joint, and are held to their work by springs, which, when a stone or other obstruction presents itself, give way, and the rake falls back until the obstruction is passed over, when it immediately returns to its work. When in motion, the working-apparatus turns in the contrary direction from the carriage-wheels, scattering the hay behind it in every direction. They make four and a half revolutions to one of the carriage-wheels, so that the hay is effectually separated and exposed to the influence of the sun and air, and this at the rate of one and a half acre per hour, supposing the horse goes at the rate of two and a half miles in that time. The machine is generally worked with one horse; and so useful has it been found, that on a farm of considerable extent it is calculated that it pays the purchase money in a single season.

There are several makers of the hay-tedding machines, but their productions are constructed nearly on the same principle as the above. When first introduced, these machines performed only one operation—that of scattering the hay in all directions over the field; but by another process they now slightly raise it from the ground, and scatter it behind the machine. In Smith and Ashby's machines the rakes are divided into two parts, so that if an obstruction presents itself, only one half of the length of the rakes is affected by it. The machine has also a backward action as well as a forward one, which enables it to perform the operation just referred to.

SECTION XIX.

THE HORSE-RAKE.

This implement has been in use, in one form or other, for many years, but has undergone various modifications since the attention of the machine-makers has been directed to the construction of agricultural machinery. The rake commonly in use consists of a square wooden frame, about 9 feet long by 2 feet 6 or 9 inches wide, and the bars of which it is composed $2\frac{1}{2}$ inches square, except the front one, which is 3 inches. The handles are joined to the bolts or bars, which are a continuation of the shafts, and also to the lifting-bar; so that by lifting them when at work, the tines are raised from the ground, and are cleared from the hay, stubble, corn, or whatever they may be at work upon, by light iron stripping-rods, with which, in lifting, the tines are brought into contact. The wheels of the machine are 20 inches in diameter, and are made of light cast-iron. The axles are strongly bolted to the main beam, and are kneed at 5 inches below it; so that the machine stands 15 inches from the ground. There are twenty tines, or teeth, measuring 18 inches in length, from the upper edge of the bars to which they are fixed. At the lower end these are bent forward, so as not to run into the ground, but rather to slide over the surface, collecting what is loose upon it. Each tine has a separate bar, to which it is fixed by a screw-nut. The lifting-bar surmounts the machine, being raised above it by a block, and fastened to the frame by a bolt. Small chains reach from it to the rake-heads, to which the tines are attached, and serve to lift the rake out of its work.

More complicated, and consequently more expensive, horse-rakes have of late years been constructed; but we question whether, for all purposes to which the horse-rake can be applied, a more efficient implement can be or has been constructed. The great object is to collect the material on which the rake is at work without the tines of the rake penetrating the ground; and this only requires that they shall be carefully constructed, with a curve sufficient to collect the hay, &c., and at the same time keep the points from entering the soil, or dragging it with the hay. And these objects a skilful machinist may accomplish with the most simply-constructed and inexpensive implements.

SECTION XX.

THE CORN DRESSING MACHINES.

A great number of machines of this description have been invented of late years by as many different machinists, each claiming superiority over every other, and many of them possessing considerable merit. Whether under the denomination of winnowers, fanners, dressing-machines, grain-separators, or any other title, they all act upon the principle of the blast and the screen, and so far perform their functions satisfactorily.

But the most efficient machine of the kind that we have ever seen in action is one invented by an American machinist, who introduced it into this country about the year 1857; since which it has made its way into a great number of mills, granaries, and farms, and with universal approbation. The following is a description of this machine, as patented by the inventors, Messrs. Owen and Child, of New Oxford Street, London :—

The frame of the Grain Separator is, in form, similar to most of the common dressing machines. Like them, it is surmounted with a hopper for receiving the corn in the first instance. From thence it passes into a *blast-pipe,* where it is met by a current of air generated by the blowers in the cylinder, which carries away over the top of the pipe the dust, chaff, and other light impurities; the imperfect corn is carried by the blast behind the division-board, and is deposited by a spout into a sack or box beneath. The head-grain, with the remaining impurities, falls upon a riddle in a shoe, resting upon four elastic wood springs. A lateral motion is communicated to this riddle by a *crank-shaft* on the opposite side.

The upper riddle, being coarse, allows the corn and other small matters to drop through to a finer sieve; whilst bits of straw, ears, and other large substances are, by the peculiar motion and surface of the riddle, delivered at a spout at the back of the machine. The fine riddle below separates and deposits the small seeds, &c., into a spout; whilst the grain is delivered into the *exhaust-pipe,* where it encounters the current of air that is supplied to the fanners. By this it is drawn upwards; and the light grains, rising the highest, fall over a partition into a spout; whilst the heavy corn, which the draught of air cannot raise so high, is deposited, in a perfectly clean state, into another spout, which conveys it into a sack. The grain, therefore, undergoes four processes; by the first, it is separated from the lighter impurities, such as chaff, dust, &c.; by the second, from the straw, bits of ears, &c.; by the third, from the small seeds, &c.; and by the fourth, from the light grains, smut-balls, garlic, &c.

Palmer's Rotatory Corn Separator is constructed on a different principle from most of the machines for dressing corn. It consists of a revolving cylinder, having longitudinal partitions of iron set side by side in the interior, and at such a distance from each other, that, as the cylinder rotates, they carry the grain up the side, but not so far as to turn it over or round its centre. The cylinder is fixed to the revolving-shaft by bars attached to iron rings at each end, and at certain distances throughout its length. It is clothed with wire-screening of different fineness, the finest being at the upper end, where the corn is introduced. The machine is turned with a winch; and, as it progresses, the grain is delivered from one part of the partition to another, and thus is divested of dust, dirt, seeds, and other extraneous substances, until it is delivered, perfectly clean, from the screen to the sacks. It will be seen that this machine is made upon the same principle as the flour-dressing machine; and, like it, the various matters separated are received into separate hoppers below each compartment. It is employed by Messrs. Clayton and Shuttleworth, attached to their threshing machine; but it is equally applicable to the hand, and has been found a very efficient corn-screen.

Until the close of the last century, all kinds of grain were dressed by *casting,* or sifting, in the wind; and these modes are still generally employed at the present day in most parts of the Continent. In such cases, advantage must be taken of the current of air, and if there is no wind, the work cannot be performed. In casting, a thorough draught is required; and, precaution being taken to prevent the grain from being cast out of the door to windward, by hanging a sail-cloth, the tasker takes his stand by the heap of corn near the opposite door; and having taken up a portion of it in his wooden shovel, he throws it high up, with a considerable spread, towards the wind. By this action, if dexterously performed, every separate grain is exposed to the draught of air; and while the lighter substances are driven back by the wind, the heavy grain is carried to the farthest extent of the cast, perfectly clean, the tail wheat falling at the leeward range of the heap. This being swept from it, the head corn is ready to put into sacks.

When the sieve is used, a wooden *horse* is placed near the barn-door on the windward side. It requires two persons to practise this operation; one to supply the sieve with corn, the other to sift it. This is done slowly; and, as the corn falls, the draught of air carries away the dust and other light substances from the head grain, which, if the wind blows steadily, is well cleaned; but the fickleness of the wind renders this operation a very uncertain one, and, like the former, it cannot be executed at all on a calm day.

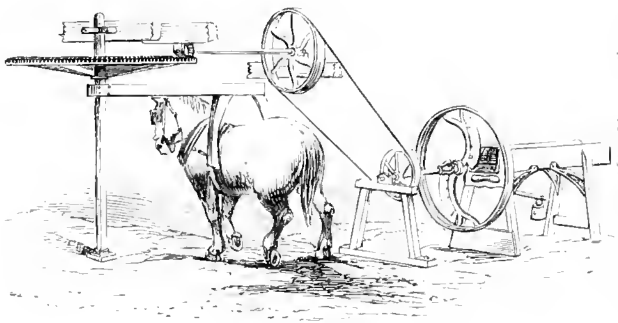
A third method was by the corn-screen, which consists of a screen about 5 feet in length, with a hopper at the top. A supporting frame is fixed by hinges below the hopper the same length as the screen. This being set out places the screen in a slanting position; and the grain being put into the hopper, runs gradually down, spreading over the wires of the screen. By this means the dust and small seeds fall through, whilst the good corn is received at the bottom, and is shovelled forward as it accumulates. The corn in this case is usually sifted previously, in order to remove straws, bits of ears, and other large substances.

All these ancient methods of dressing corn are very precarious, depending more or less upon the wind; and the two first absolutely inoperative in a calm. They are also, at best, imperfect, and require constant attention to avoid mixing the dirt or other extraneous substances with the head corn. It was, therefore, a great improvement when the dressing machine was invented, being both a saving of labour, and far more efficient and expeditious, as well as certain, in its performance.

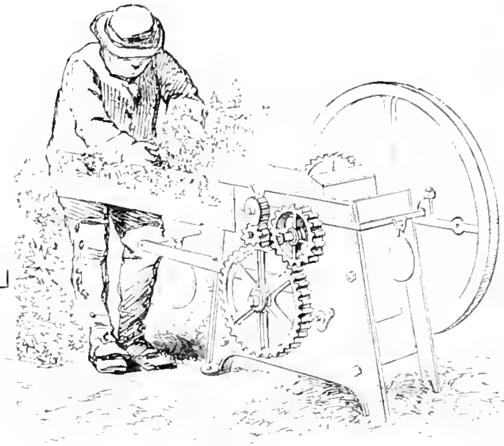
SECTION XXI.

THE CHAFF-CUTTER.

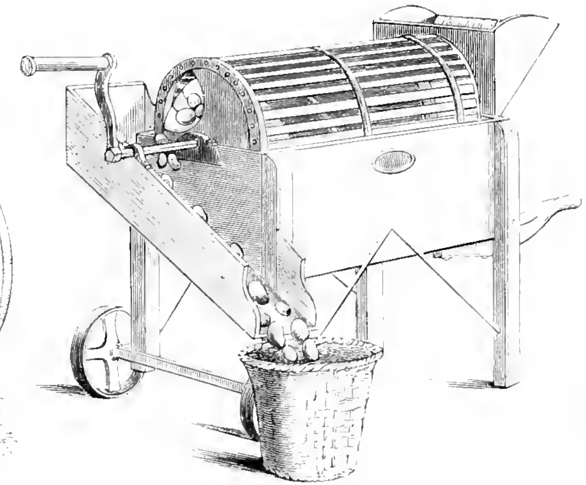
The invention of the modern Chaff-Cutter is so recent, that almost every farmer is well acquainted with the old implement, which consists of a box about 3 feet long and 6 inches wide, for receiving the hay or straw. The top of this box, or trough, is open, except at the cutting end, where a square piece of board is placed, connected by a string with a treddle below. A fork is also fastened to the frame for the operator to push forward the hay, which, being shoved under the loose board the required distance, the man presses on the treddle with his foot, which squeezes the hay, and at same moment, with the right hand, he cuts off the end of the hay close to the end of the machine with the knife, which is hung loosely to the side with a lifting joint. The man



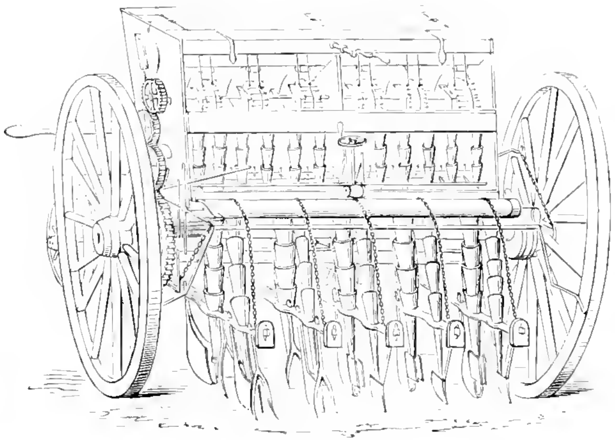
OVER-HEAD HORSE GEAR.



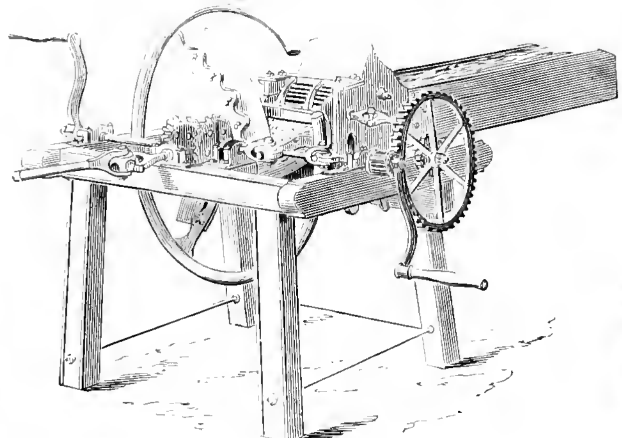
GORSE MACHINE.



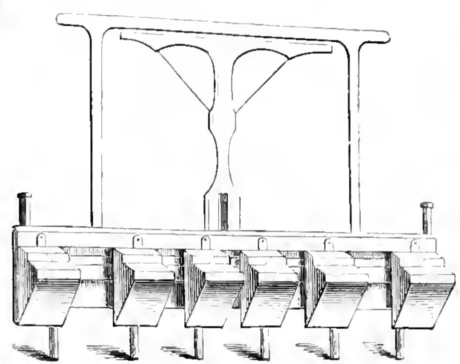
CROSSKILL'S ARCHIMEDEAN ROOT WASHER.



GENERAL PURPOSE DRILL.



CHAFF CUTTER.



DIBBLING MACHINE.

has, therefore, three operations to perform at one and the same time;—to push forward the hay with his left hand; to press it down with his foot on the treddle; and to cut it with his right hand. It requires considerable dexterity and practice to perform these operations properly; and they are still in use in towns, where persons keeping horses choose to have their chaff cut on the premises, instead of buying it, ready cut, of the corn-chandlers, which is now the common practice.

On all farms, however, of any considerable extent, the modern implements are now in use, most of them having two knives, some of which cut with a convex, and others with a concave, edge. The knives are fixed by screw and nut to the arms of the fly-wheel, and present a bevel edge to the end of the machine. The frame is on four or six legs. The box, or trough, in which the hay or straw is put, as well as the frame itself, is generally made of cast-iron. The machinery by which the operation is effected varies greatly in its arrangement, being much more simple in some than in others. Some have the knives fixed to a cylinder, or to wheels in an oblique position. In all, the hay or straw, being put into the trough, is caught and pressed forward by passing between rollers, which are acted upon by the fly-wheel, set in motion by a winch. Those manufactured by Messrs. Richmond and Chandler have met with general approval from persons who have used them. The chief difference in this form of machine is in the employment of toothed rollers for pushing forward the hay, and the non-liability to get stopped up. The bed-plate of the frame is 2 feet 8 inches in height from the ground, and 3 feet 4 inches in length; 1 foot 9½ inches in width in its narrowest part, and 1 foot 11 inches in that part in which the trough rests. The fly-wheel to which the knives are attached is 2 feet 9 inches diameter, and it hangs on a shaft in the centre of the machine, the shaft itself being supported on steps bolted to the sides of the bed-plate. A series of spur-wheels and pinions is attached to another shaft, which, at the other extremity, engages with another wheel of similar size, with the pinion on the shaft of the fly-wheel giving motion to the upper roller. The feeding-mouth of the machine is 9 inches in width, and it rises from 1½ inch to 4 inches, regulated by a swing joint. The trough is 4 feet in length. This machine, by a little alteration in the gearing, may be used for cutting gorse or furze, the rollers serving, by their serrated form, for crushing the gorse before the knives.

SECTION XXII.

ROOT-CUTTING MACHINES.

THIS is another new class of implements of husbandry, and have arisen out of the improved mode of consuming the turnips and mangold crops, by feeding the sheep in troughs instead of letting them eat the roots on or in the ground. The advantage of this in the saving effected in the roots, and the superior cleanliness, is very great; nor is it less useful in feeding the crones which cannot bite the whole turnip, especially the swedes, being destitute of teeth. In the first instance a chopper was used indifferently for topping and tailing the turnips, and for cutting them for the bullock-bins; but when the *stabulation* of cattle was adopted, and it was found advantageous to give them their food in a more systematic manner, machines were invented for reducing it to a form in which it could be eaten more expeditiously, and probably with better effect.

The first form of turnip cutting implement was a "Hand-chopper" with cross blades, which divided the root into four quarters. The four blades were of steel, fixed in a handle about 4 feet long, with a *cot* at the end to hold it by when using it. It is sometimes made to cut the turnip into six, and even eight parts, but four blades is the most usual number. Another of the same class of simple implements is in form of a fork, the tines brought near together, and having at the extremity of each a steel blade parallel with each other, and about 1½ inch asunder. This machine cuts the turnip into three slices, the middle one being the thickness of the distance between the blades, the others according to the size of the turnip.

Following the course of invention, or rather that of the simplicity of construction, we come to the lever implement invented by Mr. Wallace. It consists of a narrow stool, or frame, on four legs. The slab, or top, is in two pieces, with a space between them large enough to receive the largest root. The two parts are bound together at the sides by iron bars; the lever, which is 4 feet long, is fastened by a hinge to one end of the frame, &c. It is of the same width, except towards the handle end, which is rounded off. A piece of wood, that fits into the opening in the centre of the frame, is furnished with iron studs to hold the turnip to the cutting-blades. These are fastened to a frame inserted in the opening. The turnip is thrown upon these, and the block being pressed down upon it by the lever, it is cut into slices, which fall into baskets placed below. There are usually eight cutters; and when used in cutting turnips for sheep cross blades are inserted, which reduce the root into long, narrow pieces.

The Gridiron Turnip Shears works by a lever, which moves six knives, or shears, with an up-and-down action. It is worked with the right hand, whilst the turnips are placed by the left to the knives. The cutting-apparatus and the trough are supported by a skeleton frame running on two wheels in front, and having two legs and handles behind, so that it can be moved about to any place where it is wanted.

The Wheel Turnip Cutter, of which there are several modifications by different makers, consists of a frame like a wheelbarrow, on which is mounted a hopper on the top rail, having a sliding bottom. A disc of cast-iron rests by its axle on the two upper rails, and to it are attached three steel cutting-knives radiating at equal distances from the centre to the circumference, and having their sharp edges, when in action, in close proximity with the spout of the hopper. The disc is turned by a winch-handle, and the oblique position of the bottom of the hopper brings the turnips in contact with the knives as fast as the disc revolves. The machine is the most efficient of any we have described, and being furnished with a pair of cast-iron wheels, is very convenient to move about to the required position.

A root-grater has been invented by Bushe and Barter, which acts on the principle of the disc; but instead of cutting-knives has a series of eighteen rows of small cutters radiating from the centre to the rim. Its action by a winch-handle is the same as that of the preceding, and it cuts, or rasps, the root into very small shreds, suitable for sheep.

Another root-grater has been produced by Bentall, of Maldon, Essex, which performs by a barrel instead of a disc. To this barrel, or cylinder, are affixed twelve rows of hooked teeth, eight in each row. An Archimedean screw is fixed underneath the barrel, but close to it, so that the teeth of the barrel may correspond with the threads, and pass through them in revolving. By this united action of the barrel and the screw the roots are completely pulped.

There are now almost as many varieties of root-cutters and pulpers as there are machinists; and the principles on which they act are so well understood by the farmers that a purchaser finds it difficult to make a selection. The same circumstance, however, prevents him from choosing amiss. Some are more complicated, and consequently more expensive than others; but as these qualities do not always ensure greater efficiency, we would recommend him to examine the working of any machine before concluding a purchase, and select that which combines economy in price with greatest perfection of operation.

SECTION XXIII.

OIL-CAKE CRUSHERS, ETC.

These machines are necessary for preparing the cake, either of those kinds for feeding cattle, or those for manure. Their construction is simple, consisting of a strong frame of wood, on which rests a revolving axle, the middle part of which is enlarged to a cylinder armed with a series of strong teeth, which revolve in close proximity with another series fixed to the frame. The cake is put between these, and is crushed to the required size, which is regulated by the cylinders being placed nearer, or removed further from, each other. The machine is worked by hand with a winch, and a fly-wheel is attached.

There are several different modifications of this machine, more complicated, and rendered easier to work by additional wheels and pinions; but the principal improvement is the introduction of two rollers, or cylinders, moved by a wheel in opposite directions. The periphery of the wheel is cogged, and a pinion 3 inches diameter attached to the end of the shaft that turns the fly-wheel, and close to the winch-handle. The rollers are furnished with knobs, or teeth, and revolve at equal speed. The cake is placed in a feeding-frame above the teeth, so as to fall just between the two rollers; the extent to which they are broken being regulated by the distanee the teeth are from each other, and these can be altered at pleasure by turning a screw which acts upon one of the brass bushes of the rollers, the other being fixed.

Messrs. Ransome and Sons have brought out a cake-crusher of a very complete and compact form. The principle is the same as that just described, but the working part is enclosed in a casing, with a shoot to deliver the broken cake into a basket or other receptacle.

SECTION XXIV.

THE BONE-MILL.

At the present time, when a steam-engine is found on almost every farm of any considerable extent, and especially when the adulteration of bone-dust with "scutch" * and other almost worthless materials is constantly practised, many agriculturists have been anxious to manufacture their own bone manure, so as to have it pure and free from all adulteration. A small machine for the purpose has recently been invented. This machine consists of a strong frame of wood, firmly fastened to the floor. An upright shaft forms the axis of the machinery. A long pole, or bar, is attached to it horizontally, to be used, if animal power is employed, to yoke the horses to. A bevelled horizontal wheel is attached to the shaft for moving a vertical wheel. On the axle of this wheel is a cylinder, armed with grooves and teeth. At the other end of the axle is a small wheel, which turns another of the same size on the axle of a second cylinder, armed in a similar manner. The grooves and teeth are so placed that they close into those in the opposite cylinder, and thus crush the bones between them, which are supplied from a hopper above. Another pair of cylinders, with smaller teeth, are situated below the first, and are turned by an intermediate wheel working into that of the first pair of cylinders. A large wheel, working into a pinion on a fourth shaft, turns a cylindrical sieve, or riddle. The small pieces of bone fall through this sieve, whilst the large are thrown out at the end, and are again put into the hopper. If the mill is to be worked by steam, water, or wind, the required machinery must be attached to it for that purpose; but the grinding apparatus is the same.

SECTION XXV.

THE TILE-MACHINE.

The invention of this machine dates no further back than about the year 1835 or 1836, and the first public notice of it by the Royal Agricultural Society was in its Journal for 1840 (vol. i. p. 350). But it would appear, from a publication by Mr. Read, that he made and used pipe-tiles for land-drainage so early as 1795, forming them on a round piece of wood, and having holes all along the part next the subsoil; they were three inches diameter in the clear. These, however, were too expensive to come into general use; and this was the case with all the modifications of brick and tile for draining, until about the year mentioned above, when the Marquis of Tweeddale invented a machine, which was soon taken up and improved by the machinists. The first of these was the Yester patent, which was immediately followed by others. The marquis's machine is

* Scutch is the refuse lime thrown aside by the tanners after its virtue is exhausted.

thus described:—"A trough is made at the head of the machinery of the exact width of the intended tile. Into this trough the clay is placed by a workman, and is drawn through two revolving cylinders, compressing it with great force, so as to give it a consistency and firmness unattainable by hand labour. The clay thus flattened by the rollers is drawn forward on the machinery by a web of canvas, and passed through moulds which give it the exact shape which it may be required to bear, when it is cut off by a very simple process at any length the maker may desire. Thus, every tile being pressed in exactly the same manner, passed through the same moulds, and cut off at exactly the same length, they exhibit a uniformity of size and construction which is not to be obtained to a similar extent in any other manner. The tile being thus made, is carried away by an endless-web passing over rollers which are turned by the same machinery that makes the tile, and thus travel of their own accord, without the labour of carriage, between the sheds erected for their reception, in which they are placed in rows on either side by labourers stationed for the purpose. By this means, four or five men can in a day make from 8,000 to 10,000 tiles with ease, each fifteen inches long."

Irving's machine, exhibited by Ford at the first show of the Royal Agricultural Society, was still more simple. It consisted of a box, into which the clay being put, was forced out in a flat shape, like the leaves of a book standing upright. These were taken off by boys and bent into the proper shape. One man and four boys could make 5,000 tiles a day.

The principle having once been established, the course of improvement was rapid, and machines, to be worked by hand, were brought out by Exall, Ransome, Etheridge, and others, in a very short time. It is unnecessary to describe these, as the introduction of further improvements for expediting the manufacture has revolutionised both that and the price of the manufactured articles. The present modern machines no longer use the potter's wheel to form the pipes after the clay has left the machine, as was the case in the first instance, the pipes being perfectly formed by one operation, and at such a rate that 10,000 can be turned out in one day of ten hours by a single machine—two men and five boys being employed; the two former to work the machine, and the boys to cut off the tiles and stack them, and to supply the clay to the men. The following is a description of Clayton's machine, which has gained the approbation of the public. The frame is formed of strong upright timbers, or of cast-iron, and is either fixed or running on wheels. On this the machinery is placed, consisting of a box containing the dies for four or more tiles; a cylinder above the box, for receiving the clay; and a piston supported by a cross-bar at the top. Two axles pass from one side of the machine to the other. The upper axle passes behind the box containing the dies, and has at one end a large pinion to work into a spur-wheel on one side of the machine, and a small one at the other end to work into the larger spur-wheel. To the end of the upper axle the crank handle is attached, by which the machine is worked by hand. Two cylinders for receiving the clay are slung on the platform, which are alternately placed under the piston; this is moved up and down by a rack, and by its action forces the clay upon the dies. The piston does not reach within 3 inches of the bottom of the cylinder, in order that there may be no break in the continuity of the clay in the dies by interchange of the full for the empty cylinder. The box contains the dies, which may be of any form or size required. Openings of the proper size are made in the front of the machine, through which the clay is forced upon a platform consisting of an endless web lying on a series of rollers, which move the pipes forward as they are protruded from the machine. The pipes are cut into lengths by wires moved by the machinery, by means of an apparatus for the purpose.

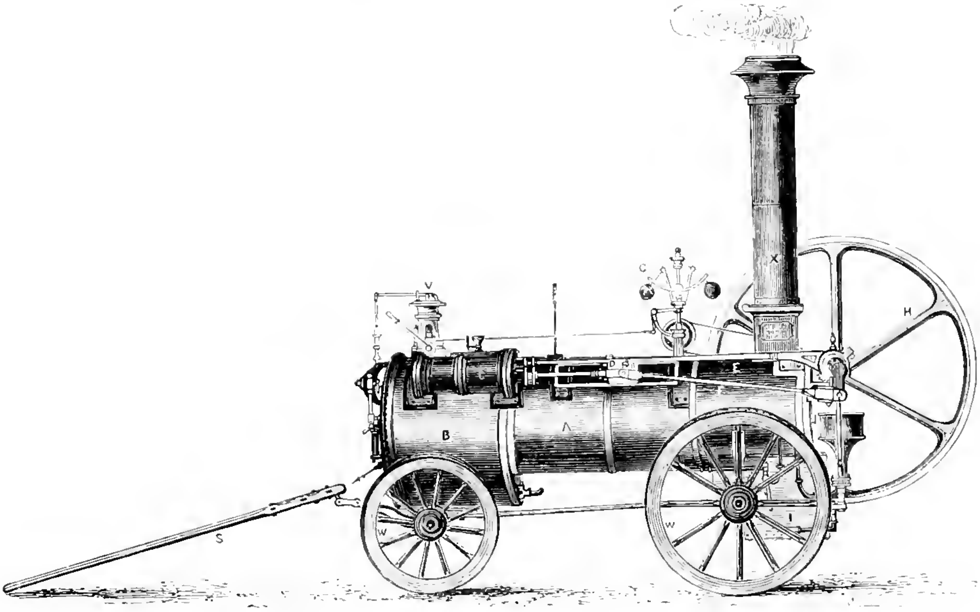
SECTION XXVI.

THE STEAM-ENGINE.

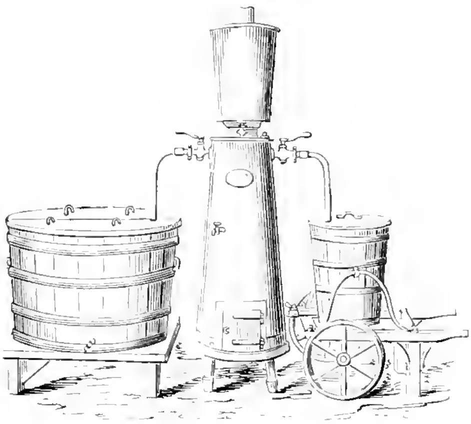
After a struggle which appears to have commenced upwards of two centuries ago, but which only of late years has attracted the serious attention of the public, the Steam-Engine has established itself upon the farm, and is now become one of the necessary adjuncts to the catalogue of agricultural implements and machines on every farm of any pretensions. We, therefore, feel it incumbent upon us to give some account of the history of this application of the new power, which bids fair in time to supersede animal power upon the farm, as it has done in almost every other branch of industry in which it has been employed.

"Great events often arise from small causes." If history or tradition speaks the truth, this old proverb is verified in the case of the steam-engine; it being asserted that the idea of the motive power of steam, and its application as such, was first suggested by seeing the lid of an iron pot rise spontaneously, even when the young urchin who was set to watch that it did not boil over, had placed a weight upon it to keep it down. If this was really the case, it must have occurred more than 240 years since; for, as we have shown at p. 592, in 1618, Ramsay patented his invention, which could have been nothing less than a steam apparatus for ploughing and other operations of husbandry. In the then existing state of scientific knowledge, steam must have been a formidable power in the hands even of scientific men, unacquainted as they must have been with the proper regulation of it. Such was the case indeed after steam-power had been applied to the arts and manufactures; and even at the present time, with all the improvements in the steam-engine, it is still a dangerous agent in the hands of careless or unskilful persons. It is not improbable that this circumstance may have operated to check the introduction of this power upon the farm, until such improvements were effected in the construction of the steam-engine as would render it comparatively harmless and much more manageable. We have already given a short history of the various machines invented for the use of the farmer, and which all failed of obtaining the public support, each of them possessing one or another imperfection that operated against their adoption.

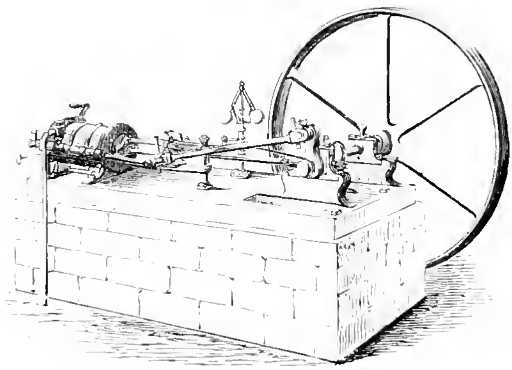
It was not, however, in ploughing or cultivating that steam was first applied on the farm. The Threshing Machine, which had been introduced at the beginning of the present century, worked with horse-power, was foremost in yielding to the new agent. But having once obtained a firm and successful footing, it became only a question of time when it should be applied to other departments of the farm. All the minor operations of the homestead have been successfully performed, and at length the plough



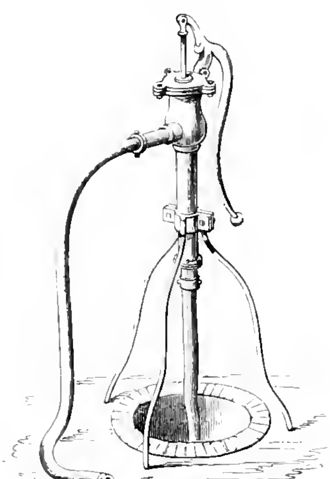
PORTABLE STEAM-ENGINE.



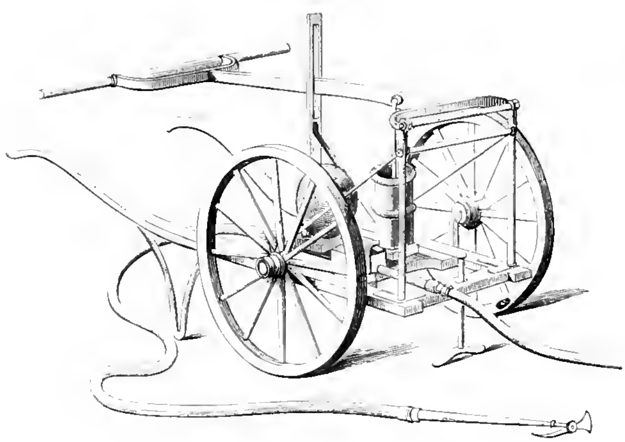
STEAMING APPARATUS.



THE HORIZONTAL ENGINE.



LIQUID MANURE PUMP.



FIRE ENGINE AND LIQUID MANURE PUMP.

itself has yielded, and it is now under consideration whether it will not be desirable to banish animal power, at least in part, from the farm, and substitute what appears destined at no great distance of time to be the only motive power employed in the industrial occupations of the country. Steam cultivation is now no longer a speculative undertaking, but an established fact; and, however capable of further improvement and extension, as to its uses, the steam-engine has firmly proved itself upon the farm to be the most efficient, economic, and universally applicable power in existence.

In the construction of the steam-engine the manufacturers have effected great improvements, and may almost be said to have arrived at as high a degree of perfection as it is capable of. The invention of the High-pressure Engine, and the economising of fuel, have reduced the expenses of working to the minimum; whilst the introduction of the portable engine, for which the public are indebted to Messrs. Tuxford, of Boston, has rendered the application of steam-power to every operation of the farm easy and direct. On the other hand, so much is the management of the engine simplified that any farm labourer of common intelligence may in a few days learn its use, so as to conduct almost every operation by it without danger. It is the opinion of Mr. John C. Morton, who has studied the subject deeply, that steam-power is, upon the average, from 50 to 100 per cent. cheaper than horse-power. We have a striking instance of this in the working of the drain plough. When that machine was first used it was worked by horse-power, and without the capstan it required the strength of more than thirty horses to draw it, and the greatest confusion prevailed in the effort to maintain uniformity of draught. "In their struggling attempts," said Mr. Mechi, "the outsiders compressed those in the centre, until a cloud of steam arose from the excited and oppressed animals. Compare this with the tranquil grandeur of a twenty, fifty, or four-hundred horse-power engine. In comparing horses with steam we could only allow a horse to work *full-collar without intermission or rest for four-and-half hours;* that would be an ample day's work, and it would cost 2*s.*, because a large well-fed draught-horse cannot be kept for less than £30 per annum. Let us see what my own steam horse costs working ten clear hours per day full-collar; and my engine is not of the latest improvement, having been in use ten years. The exact measure of one strong horse-power in steam is the evaporation of six gallons, or 60 lbs. of water, per hour. My own engine evaporates fifty-four gallons per hour, and therefore gives nine horse-power, working ten hours per day, which is equal to eighteen real horses working five hours per day.

	£	*s.*	*d.*	£	*s.*	*d.*
I burn ½ ton of coal-dust at 9*s.*	0	4	6			
Cartage	0	1	6			
	0	6	0			
Horse-power would cost				1	7	0

One labourer at 2*s.* per day manages my engine, feeds it, and cleans it. How much more would it cost to attend on eighteen horses?"*

There are really only two classes of steam-engine in regard to the principle on which it works—the *High-pressure Engine,* which discharges the steam into the air from the piston, and the *Low-pressure* or *Condensing Engine,* which passes the steam into another vessel, where it is condensed, and produces a vacuum. The latter, in fact, was

* Paper on "Steam in Agriculture," read before the Central Farmers' Club, May, 1859, by Mr. Alderman Mechi.

the original invention; but being more complicated, and therefore more difficult to understand, it is consequently less employed on the farm, and is necessarily confined, when used, to the fixed engine; whilst the portable engine is as necessarily a high-pressure one.

The principle on which steam-power is based is that of expansion, which is produced by the decomposition of water by heat; but mere expansion would not in itself possess power, or rather be able to exercise power, unless it is confined. The iron pot to which we referred at the commencement of this section is a homely, but a perfectly correct and conclusive illustration of this principle. The rising and falling of the lid as the steam was generated, represents exactly the action of steam upon the piston in the engine. If the lad who watched the pot had been able to tie or press down the lid so that the steam could not raise it, the pot would have burst, as no power, or strength, or weight of material, is able to resist the force of steam.* In order, therefore, to render the steam generated in the boiler of the engine effective, it is necessary to subject it to alternate confinement and freedom, and this is effected by the employment of the piston and cylinder. This latter is a tube, usually one and a half times, or twice, the length of its diameter. Its bottom is cast with it, but the top has a lid or cover fastened over it with screws. It has an opening at each end; at the bottom to receive, and at the top to discharge, the steam. The piston consists of an iron rod, having at the lower end a metal plug exactly fitting into the cylinder, so as to prevent the steam from passing at its sides. The rod of the piston is passed through a hole in the lid of the cylinder, and means are employed by packing to prevent steam from escaping through it. Both the apertures for the admission and discharge of the steam are provided with valves. The expansion of the steam in the boiler opens the bottom valve, and drives the plug of the piston upwards until it arrives at the upper aperture, where the steam escapes, and the atmospheric air being admitted, the piston again sinks to the bottom, and the action is repeated.

The piston being the intermediate agent by which the power is applied to the machinery, the velocity with which it is moved determines the speed in working; and this is calculated by the number of strokes per minute, which, again, depends upon the quantity of steam generated in the boiler. The engineer who works it ought to be fully conversant with the scientific nature of his profession, so as to regulate the supply of water by the speed at which the engine works, and not to force the machinery beyond the strength of the boiler.

In order to apply the power thus produced, as the action of the piston-rod is straight up and down, it is necessary to produce a rotatory motion; for which purpose an inflexible rod is hinged to the top of the piston-rod at one end, and to a crank at the other. This is termed a connecting-rod, and by its means motion may be applied to every kind of machinery and to every purpose of industry.

The elasticity of steam has enabled the engineer to economise it by a method thus described by Morton:—"If the steam in the boiler is generated as rapidly as the piston

* A remarkable instance of the power of steam happened in a foundry in the north of England. The workmen were engaged in casting an iron column of several tons weight. Through the carelessness or oversight of those concerned, some damp was left at the bottom of the mould. No sooner was the melted metal poured into it than the damp expanded, and ejected the whole mass of liquid iron into the air, scattering it in every direction, and destroying the lives of the men who were engaged in the casting.

moves, the motion of the piston will be uniform, and the steam in this case acts only like any other fluid. But steam is an elastic fluid, and to reap the full benefit from its application, we must take advantage of its elasticity. Suppose, when the piston has been driven along half the length of the cylinder, the valve which admits the steam is shut, we shall then have half of the cylinder filled with an elastic fluid, whose expansive force will still tend to urge the piston forward, but with a constantly decreasing power. When the piston has arrived at the end of the cylinder, the quantity of steam which originally filled half the cylinder will then fill the whole of it; that is, it will have expanded to twice its bulk, and the pressure at the end of the piston's course will be only half of what it was when it was at the middle of the cylinder. The result in this case would be an increase of 75 per cent. in the mechanical efficiency of steam."*

When, however, steam is thus used expansively, the pressure constantly decreases on the piston, decreasing also the velocity, and producing unsteadiness of action in the machinery. To remedy this the *fly-wheel* has been invented. The principle on which this acts is as follows:—"When the impulsive force exceeds the load, it imparts a slightly increased motion to the wheel. When the impulsive force becomes less than the load, the moving force (in excess) absorbed by the wheel *is given back*. Thus, the *fly-wheel* is a reservoir of force—absorbing it when it is in excess, and giving it back when it is deficient."†

The economic efficiency of a steam-engine consists in the quantity of fuel it will consume per horse-power in a given time, and this varies materially in different engines. At the Royal Agricultural Society of England's Meeting at Chester in 1859, the trials of steam-engines displayed a wonderful similarity of perfection in this respect. A given weight of coal was allotted to the several competitors, and the following were the results:—

EIGHT HORSE-POWER ENGINES.

	hrs.	min.	
Messrs. Tuxford and Sons	3	35	
„ Clayton	3	2	33 min. less.
„ Hornsby and Co.	2	40	55 „

TWELVE HORSE-POWER ENGINES.

	hrs.	min.	
Messrs. Tuxford and Sons	2	57	
„ Clayton	2	41	16 min. less.
„ Ransome and Sims	2	29	28 „
„ Hornsby and Co.	2	25 ‡	32 „

The Condensing Engine has, besides the several parts we have described in the principle of the High-pressure Engine, a *condenser*, an *air-pump*, a *hot well*, a *cold-water pump*.

The condenser is a hollow vessel, kept constantly immersed in cold water. The steam flows into it, and is instantly refrigerated and reconverted into water again. This creates a vacuum in the condenser, into which the steam continues to rush, the water into which the steam is converted being drawn off by the air-pump. A portion of cold

* Morton's "Cyclopædia of Agriculture," vol. ii. p. 918. † Ibid., p. 919.

‡ It is worthy of remark that in the first instance Messrs. Tuxford very properly gained the first prize; but in the second it was awarded to the *lowest* in the scale—Hornsby and Co.

water is admitted into the condenser through an *injection-cock;* and this, with the air that escapes with it, is pumped out by the air-pump, so as to leave a complete vacuum in the condenser. The hot well is a cistern which receives the *hot water* drawn by the air-pump from the condenser, to be again used, instead of cold water, for supplying the boiler. The cold-water pump supplies the well of cold water in which the condenser is placed.

The High-pressure Engine is worked either with a beam or a crank. Other forms of action are employed, but these are the most usual ones adopted in farm work. The crank is most generally approved, as the beam could not conveniently be employed in the portable engine, which is now generally in use where only one is kept. This is called the "*direct action,*" the connecting-rod uniting the cross-head of the piston-rod to the crank-piece. They are made either horizontal or vertical, but in fixed engines the former is the most common, as being more immediately under inspection and control. Some of these have an apparatus for heating the feed-water before it is pumped into the boiler. This is effected by means of a large pipe under ground, into which the exhausted steam from the cylinder enters at one end and passes out at the other; the feed-pipe, with the cold water, passes through the large pipe, and thereby receives the heat of the steam in its passage to the boiler. This plan is the invention of Messrs. Clayton, Shuttleworth, and Co., of Lincoln, and effects a considerable saving of fuel.

Messrs. Tuxford and Sons, of Boston, now build their portable engines with a closet containing all the material parts of the working machinery. The advantage of this is their preservation from dust, dirt, and accidents. It is objected to this mode, that when out of repair, the machinery is not so readily accessible for the purpose; but as every engineer is, or certainly ought to be, acquainted with all the parts of the machinery, and to know how to take it to pieces and put it together again, there can be no great difficulty about it.

In principle, the various forms of the portable engines used in husbandry are so much alike, and so near perfection, that they require no separate description. There is, however, a vast difference in the *finishing* of the engines; and it is generally acknowledged that the Boston firm above mentioned excel in this respect, and that their engines, in consequence of their highly-finished machinery, work with more ease and celerity than any others. That fuel, and consequently power, is economised by them is proved by the result of the competitive trials at Chester, as stated above. We have therefore referred particularly to their portable engine as the most perfect type of that machine used on the farm. It should be observed that the eight-horse engine which obtained the prize was a *multitubular* one, the principle of which consists of having a number of tubes enclosed in a cylinder, instead of a boiler, to contain the water. This plan is adopted also by Hornsby and other machinists. The success of Messrs. Tuxford in the manufacture of steam-engines is greatly promoted by the correctness of the fittings and the remarkable adjustment of the parts to each other. Their engines, in fact, are interesting as highly-finished works of art, and the extensive circulation they have obtained amongst agriculturists is a sufficient proof of their utility and practical excellence.

PART VII.—DRAINAGE; MANURES; THE DAIRY; IRRIGATION; SOILS; SEEDS, ETC.

SECTION I.

DRAINAGE.

It is a common saying that "fire is a good servant, but a bad master." The same may be said of water, as applied to agriculture. The three grand promoters of vegetation are light, heat, and moisture. The first is never in excess; the second seldom in this country; but the third requires constant vigilance on the part of the husbandman to keep it from predominating to the injury of his crops. Water should have no abidance in the soil beyond keeping it in a moderate state of humidity. The rain-fall brings with it the fructifying elements of vegetation from the atmosphere, and prepares them for the sustentation of plants; but having performed its functions, a filtration through the subsoil, either natural or artificial, must be provided, otherwise the good effected by it will be neutralised by its longer continuance in the soil. Being divested of its useful elements, it becomes positively poisonous to plants, as is exemplified in the case of flowers raised or kept in pots, which will not thrive unless a hole is left at the bottom of the pot, to drain off the water after it is divested of its useful properties, and, if the water remains many days, it will putrefy, and the plant will die. It is exactly the same with plants in the field on the large, as with flowers in a pot on the small, scale. In wet, retentive, undrained soils, nothing but the coarsest and most hardy plants, such as rushes, coarse grasses, &c., will thrive. In spring and autumn, when vegetation should be the most active, the retention of water in the soil prevents the sun's rays from penetrating, and keeps the roots of plants constantly cold; and in summer, when the more powerful influence of the sun overcomes this tendency, the revulsion and fermentation occasioned by a few hot days are equally injurious. Even the temporary stagnation of water during the winter and spring renders the successful cultivation of crops of all kinds very precarious, destroying the weaker, and weakening the stronger, plants by decomposing and decaying their roots.

Another evil arising from the neglect of drainage is the interruption it occasions in the tillage of the soil, so that an undrained farm is always a late-sown one. We frequently hear the occupiers of such farms saying, "Oh, it would not do for us to sow early, for if we did, our land is so wet and cold that the seed would rot in the ground." This is true enough; and the remedy is to get rid of the moisture by drainage. In Scotland, the seasons have been advanced in spring, by drainage, three or four weeks; and the autumn prolonged to an equal extent; so that now there is but little difference in the ripening of the crops between that country and England. Indeed, such is the delay occasioned by the presence of water in the retentive and undrained soils of the latter country, that the harvest is frequently thrown into a portion of the season when the shortening of the days, the diminished power of the sun, and the increasing coldness of the nights, cause the grain to ripen slowly, and greatly protract the time of harvest.

An undrained country is also an unhealthy one for animals as well as for vegetables. In winter, the climate is colder, and subject to excessive frost; whilst in summer the profuse exhalations produce febrile diseases of various kinds. Habit may, in time, accustom the constitution to almost any climatic evil; but, as a rule, a country subject to such influences as the constant presence of stagnant water exercises, must necessarily be one in which the duration of life is short. We see the effects in houses that are not properly drained, or which stand in the vicinity of stagnant ponds or ditches. In such situations, disease of some kind or other, but chiefly in the form of fever, is almost constantly present; whilst early decrepitude and death are the rule, and extended life the exception.

Notwithstanding these evils, arising from the stagnation of water in the soil, the large quantity of moisture necessary for the health and progress of vegetation is shown by the analytical researches of chemistry, and even by the more direct and simple act of drying plants before the fire; and although the same reduction of their weight does not ordinarily take place from the common heat of the sun's rays, we see it in the plant when, arriving at maturity, it dies. During its life, its exhaustion of moisture by constant perspiration is replenished by fresh supplies, both from the earth and the atmosphere. The perspiration, like that of the animal body, serves to lubricate the leaves and stems, and to prevent their surfaces from becoming hard and dry.

Water is not only necessary to vegetation as an aliment in itself, but it also supplies it with various simple substances by its decomposition. In passing through the plant, the oxygen is separated from the hydrogen and discharged through the leaves, whilst the hydrogen is retained. This is the cause of the inflammability of all plants, and by it, in combination with carbon, wood is rendered fit for fuel. Water also acts as a solvent upon those portions of earthy matters required for the composition of plants, and which they could not absorb in a solid state.

The water with which the upper soil is saturated proceeds from two sources; it descends from the atmosphere in the form of rain, mist, and snow, which latter is congealed mist; or it rises from the lower strata, by springs, through the subsoil.* Whilst the first is the most palpable, and the most readily got rid of, the latter, from its source being hidden from view, occasions the most injury. Generally speaking, too, its fructifying elements have been absorbed by the earth through which it has already passed, so that it exercises less beneficial power upon vegetation than rain-water. This explains the reason why spring or pump water is injurious, or at least less beneficial, to plants than rain, river, or pond water, which has been long exposed to the atmosphere. Gardeners are well acquainted with this fact, and generally obtain water for their purposes from a pond or rivulet, but never from a well or spring, if it can be procured otherwise. It may easily be conceived that the constant presence of a body of such water at a certain depth from the surface must be injurious to the plant, and that

* All water in the earth probably descends from the atmosphere; and in the above remark we must be understood as referring to the *immediate* presence of water in the soil, without reference to its *remote* origin.

it must keep the soil in a state of coldness very inimical to vegetation. In fact, the roots which in a dry or drained soil would penetrate to a great depth, will never enter that portion of the subsoil saturated with the stagnant spring water, but will die, or become curled up to avoid it.*

It is a remarkable fact, that whilst a large portion of the land of England is still undrained, the importance of that operation was fully understood by the Romans, as is shown in the works of Pliny, Columella, Cato, and other ancient Roman authors. They recommend "hollow draining" obliquely across the slope of the field, at the depth of 3 or 4 feet, and explain to what kinds of soil it will prove beneficial. They used stones for filling up the drains "half way;" or, if these could not be procured, willow rods, or any coarse bush-wood, twisted rope fashion, were substituted. The outlets were formed of brickwork, and the heads guarded with large stones. Such was the practice at Rome 2,000 years ago; whilst in England there is still an angry controversy going on about the comparative merits of deep and shallow drainage; and, between the two, nearly two-thirds of the land is still in a state of nature in this respect, the quantity still undrained, according to Bailey Denton, being 21,000,000 acres, cultivated or capable of cultivation. It is true, this neglect is in a great measure owing to the landowners refusing to grant leases, or agreeing to a system of tenant-right which would secure to the tenant remuneration for permanent improvements in case of being obliged to give up his farm. That such landlords act contrary to their own interests, is saying but little; and if the mischief stopped there, it would be of little importance. But no tenant, as a rule, can do justice to his farm or himself who has no guarantee that he shall reap the benefit of permanent improvements, and, like Damocles, works with the landlord's sword, in the shape of an ejectment, hanging over his head.

The absorption of water by the soil is either the effect of *chemical attraction* or *cohesive attraction*. There are very few soils that combine chemically with water, it being expelled from them by most substances that combine with them. "If a combination of lime and water be exposed to carbonic acid, this latter takes the place of the water; and compounds of alumina and silica, or of other earths, do not chemically unite with water; and soils, as it has been stated, are formed either by earthy carbonates or compounds of the pure earths and metallic oxides." †

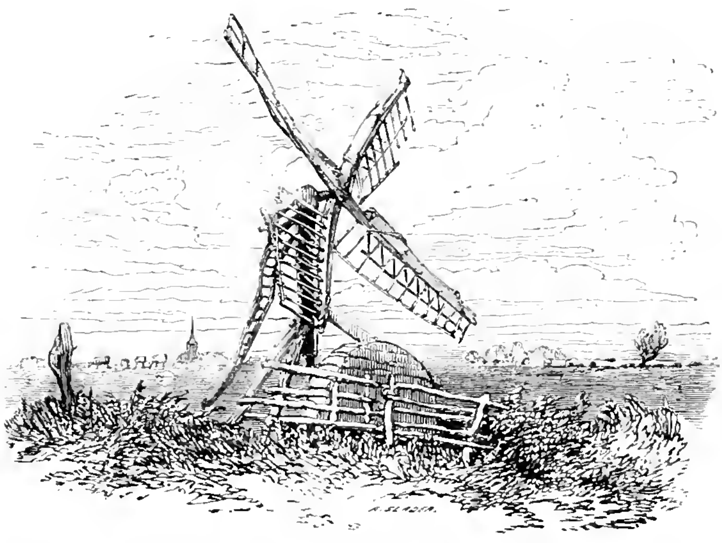
The power of *cohesive attraction* of a soil depends in a great measure on the comminution of its parts; the more these are separated, the greater is the absorbent power. This is greater in vegetable than in animal substances; and in these, than in compounds of alumina and silica; and these again are more absorbent than carbonates of lime and magnesia.‡ Without going further into the chemical part of the question, we state from the same author, that the absorbent power of a soil, in regard to atmospheric moisture, is greatest in the most fertile, and that amongst a series of six experiments, 1,000 parts of a rich soil from East Lothian, half of which was finely divided, and contained 11 parts of carbonate of lime and 9 parts of vegetable matter when dried at

* "As all water which falls in rain has undergone a natural distillation, it is much more pure when it first falls than after it has passed through different strata of earth and rises in springs. Spring-water is always found to contain some foreign admixture. If this should be only an earthy salt, the water is called hard; if it contains other substances, it then receives the denomination of mineral water."—Gregory's "Economy of Nature Explained, &c.," vol. ii. p. 552.

† Davy's "Elements of Agricultural Chemistry," p. 182. ‡ Ibid.

212°, gained in an hour, by exposure to air saturated with moisture, at temperature 62°, 18 grains; whilst 1,000 parts of the soil of Bagshot Heath, under a similar process, gained only 3 grains.* The low degree of absorptive power in this latter is probably owing, in a great measure, to its want of proper cultivation, it having been found, under a judicious system of culture, even Bagshot Heath has been rendered productive. The experiment, however, is conclusive in regard to the question involved, and proves the truth of Tull's theory, that a perfect comminution of the soil, so far from exposing it more to drought, has a directly contrary effect, and assists the absorption of moisture from the atmosphere.

Whilst, therefore, it is absolutely necessary to get rid of the stagnant water in the soil, whether by natural or artificial means, that the roots of plants may have free scope to pierce the subsoil, and enjoy a healthy vegetation, this object is greatly promoted by frequent, deep, and perfect tillage, which at the same time assists the absorptive powers of the soil in attracting from the atmosphere the moisture essential to the objects of successful cultivation.



SCOOP WHEEL.

SECTION II.

DIFFERENT MODES OF DRAINAGE.

Before going into the question of this section it may be proper to show what has been done the last few years towards facilitating and carrying out more extensively the practice of land-drainage. In the year 1846 Sir Robert Peel introduced and carried through Parliament an act entitled "The Public Moneys Drainage Act," by virtue of which three and a half millions of the public money were set apart to be advanced to

* Davy's "Elements of Agricultural Chemistry," p. 184.

landowners on the security of their estates, for the purpose of enabling them to thorough-drain their lands; the capital to be repaid (with interest) by instalments in twenty years. If the estate is entailed, the proprietor to have the power of charging a rent upon it, to be paid by the heir-at-law after his accession to the estate; the amount to be determined by the remaining value of the permanent improvement.

The readiness with which this measure was taken up by the landowners led to the establishment of several "Land-drainage Companies," which, after the public grant of money had been appropriated, were enabled to obtain a high rate of interest; but the government, seeing this, soon after passed a second bill through Parliament, entitled "The Private Moneys Drainage Act," which enabled the landowners to borrow money from any private person on exactly the same conditions as under the first act, and at such interest as could be agreed on between the parties. The competition this raised with the companies was most beneficial to the proprietors of estates, and under the two acts a considerable breadth of land has been drained; but, besides this, many of the wealthy landowners have expended their own spare capitals on drainage, the latter act allowing them the same advantage of a rent charge upon the land in case of the decease of the owner, for the benefit of the younger and the female children. The amounts of borrowed capital expended up to 1861 under the two acts were as follows:—

	£
Under the Public Moneys Act . . .	3,524,258
„ Private Moneys Act . . .	234,800
Companies' Money	1,503,496
	£5,262,554

The number of acres thereby drained is estimated at 910,000, at an average expense of £5 7*s.* per acre. The quantity drained by proprietors employing their own capital is less easy to be ascertained; but it is estimated by Mr. Bailey Denton, who is well qualified to judge, at 500,000 acres; making an aggregate of 1,410,000 acres. This is but a fractional proportion of the 21,000,000 acres yet undrained, but it is a good beginning; and when the advantages conferred by the acts are better and more generally understood, those landowners who have hitherto demurred to taking the step will find their interest directly promoted by availing themselves of it. Many of the largest properties in the kingdom, including the crown lands and those under the charge of the Ecclesiastical Commissioners, are being drained; and the principle of employing borrowed capital in effecting permanent improvements is daily extending itself. At present not more than one-sixteenth of the undrained land under, and capable of, cultivation has been drained since these acts were passed.

Of the importance attached to drainage, especially of heavy clay soils, by the tenant farmers there are increasing evidences. Formerly it was considered impossible to drain a retentive clay otherwise than by open drains, or to make the water percolate through the subsoil. Forsyth, at the beginning of the present century, was of this opinion, for he says in his work, "There are some soils that, being chiefly composed of a stiff clay, possess so great a degree of tenacity as to retain water upon every trifling depression of their surface till evaporation carries it off. It is in vain to attempt to drain such soils by hollow channels below ground, as the water will never be able to filtrate through the soil so as to reach the drain. In such situations, therefore, open draining is the only mode that can be adopted for clearing the soil of surface water."*

At the present time the owner of a clay farm would find it difficult to get a respectable tenant to take it, unless it was drained. Deep tillage, however, is necessary in such soils, in order to open them; and this, like "hollow draining," was considered injurious to a clay soil. Even Sir Humphrey Davy appears to have been of this opinion in certain cases; for he says, "Deep ploughing may be a very profitable practice on a rich thick soil; and on a fertile shallow soil, situate upon a cold clay or sandy subsoil, it may be extremely prejudicial."† So much is the opinion of the farmer on this subject changed, that the breaking up of a clay subsoil is considered the most effectual method of increasing the fertility of the surface, both by bringing up to it the organic matters contained in it, and by opening a passage for the surface water,—otherwise stagnant,—to percolate through it to the drains. Experience has proved that the drained lands endure drought better, and produce better crops, than undrained; whilst in a wet season the benefits of draining become still more palpable.

The action of draining upon clay soils is easy of explanation. It is well known that all soils expand or swell with much rain, and contract when dried. In loose or mixed soils the effect is not seen, but in stiff clays the contraction causes a multitude of fissures, which continue as long as the earth continues dry. Now, the tendency of drainage is to perpetuate this dryness, and, consequently, the cracks or fissures occur, which sometimes extend far into the ground. Draining both favours and perpetuates this tendency, and thus provides both for the filtration, and for the discharge of the surplus water in the smallest space of time.

These two operations, then,—draining and deep tillage,—should go together, especially on clay soils. Of the beautiful effects of the first some remarkable instances were mentioned by Mr. Dunton in a paper on draining, read by him before the members of the Central Farmers' Club. Speaking of the dry weather that set in (1861), just before the wheat began to ripen, he says, "It was from this period that the aeration of the soil began to tell. While the heat was increasing, the air, loaded with floating moisture and with the ammonia derived from all kinds of exhalations, travelled through the soil to the roots of the ripening corn, and maintained it in vigour to the period of complete fructification. Stress is laid on the marked difference in the quality of corn from land deeply drained and deeply cultivated, compared with that from undrained land (the appearance of the ears of which did not indicate any such marked difference), as it most beautifully illustrates the views of Davy, Playfair, Madden, and others, who have explained how the altered condition of the subsoil comminuted by drainage, and that of the surface divided, or 'smashed,' as Mr. Smith calls it, by cultivation, admits the air, with its aqueous and nutritious accompaniments, to the innermost recesses of the ground."

The question of deep and shallow draining has, as we have already remarked, been the subject of a sharp and protracted controversy between professional men; but it has been almost set at rest and decided by the new light thrown upon agriculture, and by the practice of deep tillage, especially in connection with the employment of the steam subsoil plough, with the operation of which shallow drainage is quite incompatible. In drawing up the Drainage Acts the framers appear to have been fully aware of the

* "Principles and Practice of Agriculture," vol. i. p. 311.

† "Elements of Chemistry," p. 188.

importance of deep draining, for the acts specially enjoin that the drains shall not be less than 4 feet in depth. This specific standard led to curious blunders. Some of the persons entrusted with the superintendence of the works appear to have been but ill-qualified for the task; for, adhering literally to their instructions, they caused the drains to be made exactly 4 feet deep, irrespective of the inequalities of the surface. The consequence was, that the drains, instead of having a regular and gentle fall from the head to the outlet, followed, in some cases, the undulations of the land, so that the water settled in the low parts, and materially obstructed the proper working of the drain. It is well known that a 4-feet drain will sometimes, in an undulating country, lie within 3 feet of the surface in the low parts, and even less; so that a shallower than a 4-feet drain would be exposed and liable to be disturbed by subsoiling, which will soon come into general practice. On clay soils nothing less than 4-feet drains are now admissible, and the next question is the width necessary to be observed between the drains.

This must vary according to the nature and quality of the soil. It ranges from 16 to 60 feet, and even more in some cases. A tenacious clay soil requires the drains to be close, because it absorbs and retains more firmly, as well as injuriously, the water from beneath. The heat from above, too, does not so readily penetrate a clay as it does a gravelly or sandy soil, and it is therefore of a colder nature until divested of its stagnant water. It should always be borne in mind that the object of draining is as much to prevent the rising of water from beneath as to give an exit for that which falls from the atmosphere. The former is always the most copious, continuous, and injurious, because, while it imparts none of the elements of fertility possessed by rain-water, it is uniformly cold and ungenial, communicating no warmth to vegetation, but acting rather as a check upon it. The sooner, therefore, it is got rid of from a tenacious soil the more favourable will it be to the growth of plants.

Observation and experience have shown that when springs are opened, and a free passage is made for the flow of water from them, they gradually become stronger. This proves to be the case even with wells, from which, the more they are drawn upon for water the greater the supply becomes. One cause is, that until a regular channel is formed for the water the springs cannot develop themselves, and remain in a normal state of stagnation, only relieved by those spontaneous outlets which nature and the inequalities of the ground have provided. An example of this is found in the spring from which the New River, that supplies London with so large a part of the water it consumes, proceeds, which was certainly a strong one previously, but the flow of water has probably increased fourfold, or more, since the opening up of its course. Another cause of this is, that while no adequate outlet is provided for the water of springs, it becomes diffused over the surrounding lands, which are saturated with it, and it is dispersed by evaporation only.

It is also remarkable that drainage, so far from increasing evaporation, actually diminishes it, and rather attracts moisture to the soil *from* the atmosphere than imparts *to* it. Whilst the subsoil, for want of drainage, supplies the upper soil with water from the lower water-bed, the evaporation at the surface is what may be called an effort of nature to relieve the soil from a redundancy of that element. The pressure of gravitation of the water from the higher, upon that of the lower springs overcomes that of the atmosphere; and it is only by its decomposition as it approaches the surface that it can be dispersed. We see this exemplified in all undrained lands surcharged with water, especially in strong clay soils, which are almost constantly enveloped in a mist during the winter months, when the influence of the sun is feeble, and the days are short.*

An erroneous notion of the effect of drainage led some persons, during the dry summer of 1859, to apprehend that the system had been carried too far, and that the soil had been divested of its moisture to an extent to cause the drought. This, however, was disproved by the fact that the crops upon the drained lands were, generally speaking, by far the most vigorous; and it was also ascertained that the evaporation was less, whilst the aeration of the soil opened it to the moisture of the atmosphere, and thus supplied the plants with nourishment.

Few persons are aware of the extent to which drained lands absorb the moisture from the atmosphere, independent of the rain-fall; nor could it be correctly ascertained except from its effects. When accompanied by deep and minute tillage, the soil, being opened to the depth of 15 or 18 inches, drinks in the humidity constantly floating in the air during hot weather, between sunset and sunrise. If we walk in the fields early in the summer morning, we invariably (except immediately before rain) find the grass or corn saturated with moisture from the night dews; and if this could be collected over a given space, it would be found to amount to a considerable quantity. Yet it constitutes only a small portion of what actually falls, the greater part being absorbed by the aerated soil, and appropriated by the *roots*, as the other is by the *leaves* of plants. Besides this, the drained soil is supplied with moisture from below by capillary attraction, which is constantly going on; and thus the effect of the evaporation of the day in summer is more than compensated by the night dews and the twenty-four hours of capillary attraction—the one from the atmosphere, the other from the subsoil. These operations cannot take place in undrained and imperfectly tilled land, especially clays. These, which during the winter months are saturated to excess with moisture from the rising of the water-bed to the surface after the autumnal rains, become, in a dry summer, when the springs are low, too indurated to attract the night dews; and, consequently, vegetation suffers more than on the drained free soils.

With respect to the effect of drainage on free soils, Mr. Denton has the following observations:—"The effect of under-draining on this description of soil (and, in truth, on most of the mixed soils) will be readily understood, when it is observed that no water can run from the under-drains until the water-bed has been raised by descending rains to the level of the drains; and that as the surface-springs rose higher and higher before draining, so the lowest drains will begin to run first, and as soon as the water-bed of the whole area drained, forming an inclined plane, has risen by degrees to the height of

* The following remarks explain the theory of mist:—"The atmosphere is composed not only of fixed gases, but also of aqueous vapour, and there is a much larger quantity of aqueous vapour suspended in the air during the summer season than in the winter season. That was one of the discoveries of Sir Isaac Newton. Now, there is at all times a temperature, with respect of aqueous vapour, at which water will begin to precipitate, and any body possessing that temperature, and with which the vapour is in contact, will absorb it; this degree of temperature is termed 'the dew-point.' The action of drainage is to cause air to occupy the place previously occupied by water, and to which air cannot obtain access; and the lower portions of the soil being considerably cooler than the air, causes a precipitation of dew or moisture throughout every part of them when the atmosphere is highly heated. The surface of the soil only is moistened by dew during the night; but the interior parts of the soil are abstracting it from the atmosphere during the day. This beautiful operation was first explained by Sir Humphrey Davy, &c. &c."—See Parkes' work "On Drainage." Parkes states that he has frequently taken a tea-cupful of dew early in the morning from the leaves of a single cabbage plant.

every drain, the whole system will be at work, and not till then. A portion of the infiltrated water—not an inconsiderable one in some cases—is claimed by the space in the subsoil intermediate between the level of the drains and the depth to which the water-bed may have sunk after the drains may have ceased to run in the spring. This space will be found to be more or less, according to height and aspect, as influencing gravitation and evaporation, and the extent to which the disintegration of the subsoil by drainage may promote capillary attraction. The quantity discharged by the drains, therefore, does not represent the whole of the infiltrated water, which should be understood to include, (1) the water discharged by the drains; (2) the water which sinks to the springs; and (3) the moisture which rises from the subsoil beneath the drains, by attraction, into the soil above them, to be dispersed by evaporation at the surface. In certain cases, where the surcharged lands approach the lowest outcrop of the stratum or bed, the drains partake of the nature of perennial springs, and continue to discharge the overflow of the subjacent water-level.

"When free soils are effectually drained, the water in test-holes between the under drains will generally stand at an approximate level with the drains after that level has been gained, though its height will fluctuate with the rain-fall when any appreciable quantity descends. This being the action of under-draining the surcharged free soils, the results will be, (1) to render the surface more capable of absorbing the rains which fall upon it; (2) to lower the discharge of the upper surface springs in a slight degree; and (3) to withdraw from the power of evaporation all the water which the under-drains discharge."*

The history of under-draining in England is quite of modern date, although it was known and practised by the ancient Romans. Whether they introduced it into Britain at the time of the Conquest is not recorded; but certainly, if they did, it was afterwards lost, for the first systematic plan of drainage we read of is in the work of Captain Walter Blythe, published in 1652, where he recommends the removal of all mills that are injurious to the land by damming up the water, and so preventing the drainage: and for this latter operation he gives instructions which, if they do not come up to our modern notions, are founded on the soundest principles.†

Half a century later, Tull recommends laying the lands for wheat into high ridges, with a ditch "almost a foot deep on each side," as the only way of getting rid of the rain-water. He had the clearest conviction of the injury arising from stagnant water; for he says, the more a soil is filled with water the less heat it will have." He also speaks of digging trenches across the rising ground and filling them up with stones,

* "The Effects of Under-drainage on the Arterial Channels and Outfalls of the Kingdom," read before the Central Farmer's Club, November, 1861, by J. Bailey Denton, Esq.

† The following passage is from Blythe's work, and shows the correctness of his views:—"As for the draining trench, it must be made so deep that it goes to the bottom of the cold, spewy, moist water that feeds the flag and the rush. For the wideness of it, use thine own liberty; but be sure to make it so wide as thou mayest go to the bottom of it, which must be as low as any moisture lyeth, which moisture usually lyeth under the upper and second swarth of the earth on some gravel or sand, or else where some greater stones, or mixed with clay, under which thou mayest go half one spade's graft deep at least. Yea, suppose this corruption that feeds and nourishes the flag and the rush should lie a yard or four feet deep, to the bottom of it thou must go if ever thou wouldst drain it to purpose or make the attempt advantageous for either floating or draining, without which the water cannot have its kindly operation; for though the water fattens naturally, yet still this coldness and moisture lies gnawing within, and not being taken away clean, it eateth out what the water fattens, and so the goodness of the water is, as it were, riddled, screened, and strained out into the land, leaving the richness and the leanness sliding away from it."

through which the water, when it soaks into the trenches, may run off at one or both ends of them into some ditch, which is lower, and carries it away. Then they cover it with mould, and plough over it as in the dry level ground." This is the nearest approach to hollow-draining that had then been published; but it was very imperfectly executed, for he adds, "This method has been found effectual for a time, but not of long continuance, for the trenches are apt to be stopped up, and then the springs break out again as before; besides, this is a very chargeable work, and in many places the expense of it may almost equal the purchase of the land." He therefore advises the open drains, as before described, to be drawn obliquely across the rising ground.

It is evident that Tull had no correct idea of a water-level *below* the surface, but as affecting it by its retention in the subsoil, and keeping it in a cold and ungenial state. The first person, after Blythe, who discovered the true art of land-drainage, appears to have been Dr. James Anderson, of Aberdeen, who published an "Essay on Agriculture and Rural Affairs" in 1775; but his system was confined to tapping the springs by digging through the clay, and thus making a passage for the water, conveying it by open drains wherever the descent or fall will allow. About the same time one Elkington, a Warwickshire farmer, hit upon the same plan, and commenced business as a land drainer, and by not divulging his secret respecting his knowledge of subterranean water, he became famous in his profession. Whether he took the hint from Anderson's work, or made the discovery simultaneously with him, it is impossible to say; but he was so far treated as the discoverer, that the Board of Agriculture, in ignorance, as it is supposed, of Dr. Anderson's publication, recommended him to the notice of Parliament, which rewarded him with a grant of £1,000; and thus the first discoverer, who liberally published his system for the benefit of the public, was overlooked, whilst he who kept the secret with himself received the reward. Both appear to have dug a certain depth, and then bored with an auger till they came to the body of water, on the same principle as is employed in the artesian wells, and which has been practised in Italy, from a very ancient date, in the case of well-sinking.* To avoid the expense of digging to a great depth, they bored with an auger at the bottom till they reached the stratum which contained the body of water.

It is plain, however, that the practice of both Anderson and Elkington only applied to the draining of such lands as were constantly covered or saturated with water, and thus laying them dry and in a proper state for cultivation. Hollow-draining, on a systematic plan, did not come into practice until the latter end of the century, and then it was limited to the mixed or porous soils, it being considered useless, as we have already stated, to attempt to drain the clays. Nor did drainage at all make much progress until lately, and Smith, of Deanston, was the first who reduced it to a system.

* "A curious circumstance," says Gregory, "occurs in the making of wells at Modena and Styria, in Italy. The workmen begin by digging through several strata or soils till they come to a very hard kind of earth, much resembling chalk; here they begin their mason-work, and build a well, which they carry on at their leisure till they have finished it, without being interrupted with one drop of water, and without any apprehension of not finding it when they come to make the experiment. The well being finished, they bore through the hard bed of chalk, upon which the well is built, with a long auger, but take care to get out of the well before they draw it out again; which, when they have done, the water springs up into the well, and in a little time rises to the brim, nay, sometimes overflows the neighbouring grounds. Now, there can be little doubt that these waters flow from reservoirs which are collected within the Apennine Mountains, not far from Modena, and taking their course through subterranean passages, endeavour to force their ascent to the same height from which they descend, wherever they can find a vent."—*The Economy of Nature Explained and Illustrated*, vol. ii. p. 552.

His plan was to cut narrow parallel drains in the furrows between the ridges, from 24 to 30 inches in depth, the intervals between being regulated by the character of the soil and the facility of action of the drain. He first filled up his drains with stones collected on the land, or of broken stone reduced to the proper size, or about $2\frac{1}{2}$ inches square. These were thrown promiscuously into the drain to the depth of from 9 to 12 inches, and there is no question that such drains were both efficient and durable, but certainly not so much so as pipe drains, which afford a clear passage to the water. The principle on which all drains act is that of *gravitation*. Water being heavier than air, will always find its way to places in the ground *below* it, where there is a vacant space, or rather spaces, filled with air only. This is speedily driven out by it; and it is plain that the more continuous and uninterrupted these spaces are, the more effectual will be their action in drawing off the water.

Smith appears to have modified his plan latterly, by sinking his drains to from 30 inches to 3 feet 6 inches; but he made no difference in the distances between them. The success of his plan caused it to be extensively adopted in Scotland, where draining is much more general than in England. The reasons why the system has not more prevailed in the latter country are various—chiefly the embarrassed condition of the landowners and the law of entails. Both these causes, however, are removed by the late Acts of Parliament, which we have already alluded to. It is a proof that these were the principal obstructions, that within a few months after the passing of the Drainage Acts, the applications for the money to be granted on loan far exceeded the sum allotted by Parliament in the first instance. And as to the propriety and utility of the measure, these are shown by the fact that already nearly the whole of the money thus borrowed has been repaid into the Exchequer, and the work of draining is rapidly progressing, as indispensable to the full development of the resources of the soil.

The employment of earthen pipes in the construction of hollow drains must be considered an era in the history of the art of drainage. Something of the kind was attempted about the beginning of the present century, when bricks, about a foot long and 4 inches wide, were used, having a semicircular open groove cut along the top, about 2 inches wide. These were laid, with the grooves downward, on the hard clay, or upward, with a tile over them; but the heavy expense prevented them from being used to any extent. We have already given a brief history of the Draining Tile Machine, by which the pipe tile came into use in something like its present form about the year 1845, and has been found the most simple, cheap, and efficient medium for the purpose of getting rid of the water from the soil.

Mr. Parkes, who has studied the philosophy of drainage of land perhaps more closely than any other man, is decidedly of opinion that a pipe of 1-inch bore for a certain distance, and laid in not more than 4 feet deep on any soil, is the most effectual mode of draining, except in a very wet or springy soil. His experience as a professional land-drainer is very extensive, and his treatises on the subject are conclusive as to the correctness of his views. They are confirmed in every respect by the avowed opinions of Mr. Denton, who is also extensively employed by many noblemen and other landowners in draining their estates. It is found that where there is a considerable flow of water of a ferruginous quality, a stone drain soon fills up with a deposit of iron oxide; and the same operation takes place with tiles, if they are so large that the flow of water is not sufficient to keep them clear. Tiles, therefore, with a small bore, which are well filled when the rains are heavy and the water-bed is high, are found to keep themselves free from any deposit, whether of iron or earthy particles. At the same time, they have been proved efficient in the closest clay soils at the depth of 4 feet, whilst others of 2 or 2½ feet have failed.

It is remarkable, too, that after a heavy rain a drain 4 feet deep will begin to run before one of 2 feet. Mr. Parkes tried an experiment of this kind on the Duke of Wellington's estate at Strathfieldsaye. On a piece of pasture that had been ineffectually drained he directed a drain to be dug 4 feet deep, at the bottom of which he laid tiles of 1-inch bore. Upon these was rammed hard 2 feet of clay, and on the clay was laid another row of inch tiles, and the trench was then filled up to the surface. After a heavy rain the lower tier of tiles not only commenced running first, but the flow of water was much greater than from the upper tier, and continued longer. Another drain of 4 feet was opened parallel with the other, at 24 feet distance, and served in the same manner. It then appeared that the first drain had drawn off the water to the extent of 24 feet, for the second drain had a very inferior flow from it. It is easy to account for the greater flow from a 4-feet than from a 2-feet drain, from the larger body of earth over which it exerts an influence; but it is not so easy to state why the deepest drain should be the first to discharge the water after a rain, and first to cease running, although it ought to continue it longer. The fact, however, is confirmed both by Parkes and Denton, and has not, that we are aware of, been denied or disputed by any of the opponents of deep drainage.

Another experiment is related by Mr. Parkes on a piece of hop-ground belonging to Mr. Hammond, in Kent. It had been drained from 24 to 30 inches deep thirty-five years before; but suspecting that the hop-plants were injured by the water in the subsoil below the old drains, he again under-drained it in 1842 with inch pipes, partly at 3 and partly at 4 feet deep, the effect proving very beneficial. The old drains were left undisturbed, and *ceased to run* from that time, the whole of the water passing below them to the new drains. The distance between was 26 feet, the length 150 yards, the fall the same, and the flow of water was at the rate of 19½ tons per acre in twenty-four hours.

Another advantage accruing from deep drainage is the more effectual filtration of the water after continued rain. Any one who examines the outlet of a 2-feet drain on such an occasion will not fail to find the water muddy or cloudy. This arises from its taking from the soil the finer, and certainly the more valuable, particles it contains, and such as if left would be most readily assimilable by the plants. There can be no difference of opinion on this point, or difficulty in accounting for it. Over a 2-feet drain there can be little more than from 12 to 16 inches of soil, which is quite insufficient properly to filter the water; and the consequence is as we have stated; the soluble salts and other most nutritious portions of the soil are drained away with the water; but with a 4-feet drain the distance the water has to descend is great enough at all times, even after the heaviest and most continuous rain-fall, to filter every particle of earthy matter from it, whilst the subsoil will arrest, and appropriate by its chemical attraction, the soluble salts it contains, and it flows from the drains clean and pure.

Land undrained if injured by stagnant water in the subsoil shows it most in the spring, by the colour of the soil and the weakness of the vegetation, which is always more backward than on a dry or drained soil. Dark spots appear where the water is retained during the winter, and the roots of the plants are chilled and their growth arrested. These effects are not remedied or counteracted by the subsequent drying of the land in summer. The constitution of the plants is injured, and they grow up weak and spindling, producing at harvest only half what the real quality of the soil is calculated to yield; for although the surface is dry, and the darkness of the soil has disappeared, the coldness produced by it in the subsoil prevents that development of the plant which takes place in a soil laid dry by drainage. In this latter the water passes directly downward, admitting the air warmed by the sun to penetrate, whilst on the undrained land it can only be dispersed by evaporation, which repels the air and produces a coldness in the atmosphere inimical to the progress of vegetation. On the other hand, the stagnant water in the subsoil renders the surface cold and ungenial, chilling the roots and retarding the progress of the plants. Wherever such symptoms appear there can be no doubt of either the cause or its cure. Draining is the only and the certain remedy; and thousands of acres of such lands which were previously, from the stiffness of the soil, considered unprofitable, have been rendered by it highly productive.

The appearance and flourishing condition of aquatic plants is a certain symptom of stagnant water in the subsoil, because these will never thrive where the land is dry, any more than better plants will in land sodden with water. Every practical farmer knows the water plants and grasses, and the impossibility of extirpating them from a wet soil. Even horse or hand-hoeing is of little use on such land, for as soon as the corn is too high for the hoe these aquatic plants spring up again and choke it, or draw off the nourishment from it. On such land, in fact, manure produces but little effect, its influence in ameliorating the soil being counteracted by the coldness produced by the water.

Pasture land undrained displays the injury produced by stagnant water quite as palpably as arable land. Here the aquatic plants have their full growth. Coarse and wiry grasses take the place of the more nutritive kinds, and the cattle fed on them are kept in poor condition. The coldness of the air chills them at night, whilst the multitudes of gnats and other insects engendered by the damp, torment and terrify them by day, preventing them from either feeding or resting. These evils disappear, or are modified, by draining, which improves the pasturage, tempers the atmosphere, and prevents the breeding of those swarms of insects which always accompany the presence of stagnant water.

Sheep are more especially liable to injury on land that is undrained. The foot-rot and diseased liver are the certain consequences of feeding them on such land, whether in summer or winter; and in the warm months of the later summer and autumn they are tormented with flies, which deposit their eggs in the fleece, breeding maggots in abundance. These if unseen or neglected soon destroy the animal.

The evils attending undrained lands are thus summed up by Parkes:—"Experience has proved that a soil surcharged with water cannot perfect crops; that excess of water is an impediment to the due mechanical division of the active soil; that it diminishes the fertilising power of every species of manure; that it lowers the temperature of the mass of the bed; that it precludes the free entrance and change of the atmospheric air; that it prevents the free descent of rain through the soil and its timely evacuation. . . . . The evils referable to the excess of water in soils are rendered peculiarly apparent by comparing such water-logged land with those free, deep, naturally dry and warm soils, as they are called, which are so coveted by farmers, of which every one wants a slice, but which are so rarely to be met with, in comparison with the over wet or too dry portions of the superficies of our island."*

The same author states that it is the "subterranean water, as it may not improperly be termed, to which excessive and injurious wetness is attributable; and if such water be not removed and kept down at a depth exceeding the power of capillary attraction to elevate it too near the surface, no drainage can be efficient. It is chiefly through capillarity that those soils are maintained in a sufficiently moist state for vegetative perfection, on digging into which we do not discover any free water within several feet of the surface. The effect of rain is to thoroughly moisten such soil, gravity carrying down below the excess, or that portion which the soil cannot absorb or retain."

The following is the expense per acre of putting in drains of 4 feet depth, at different distances, according to Mr. Parkes :—

Distance of Drains.	Length of Drains in rods of 7½ yards.	Cutting and filling at 8*d*. per rod.	Pipe laying and superintendence.	1½-inch pipe at 13*s*. per 1 000.	Total cost.
	Rods.	£ s. d.	s. d.	£ s. d.	£ s. d.
At 8 yards	86½	2 17 8	14 5	1 3 7½	4 15 8½
„ 10 „	69	2 6 0	11 1	0 18 10	3 16 4
„ 11 „	63	2 2 0	10 6	0 17 2	3 9 0
„ 12 „	57½	1 18 4	9 7	0 15 8½	3 3 7

It would appear, also, according to Mr. Parkes, that a much larger extent of soil is drained for the money by 4-feet drains than by shallower ones, as the following table shows:—

Depth of Drains in feet.	Distance between Drains in feet.	Mass of soil drained per acre in cubic yards.	Mass of soil drained for 1*d*. in cubic yards.	Surface of soil drained for 1*d*. in square yards.
2	24	3,226½	4·01	6·27
3	33½	4,840	8·93	8·93
4	50	6,453	12·00	8·96

New land reclaimed from the waste should be drained before it is broken up; but the fences should be first raised, otherwise, in digging the ditches the drains would be liable to be interfered with, and the roots of the live fences, also, would probably get into, and stop them up. The fields being laid out and fenced in, the first thing to be attended to is to ascertain the nature of the soil and subsoil, and the depth at which the water-bed lies from the surface. These may be found by sinking test-holes in different parts of each field, taking care to dig them deep enough to reach the water-bed, when the water will rise in the hole till it has found its level. The next operation is to examine the elevation or descent of the land so as to find the direction and amount of the fall. This cannot properly or correctly be done without either a theodolite or a spirit-level, with either of which it may be easily ascertained. On most farms the fall takes different directions, and it is necessary to note these variations, as the drains must be formed in accordance with them. Examine next the ditches or water-courses at the outfall of the lowest part of the land to be drained, and if they are not deep enough for the purpose they must be made so before beginning to drain the land. The fall in these

* Parkes' "Essay on the Philosophy of Draining," &c., p. 54.

should not be less than 1 foot in 220 yards according to Parkes, unless the outfall abuts upon a river, the fall of which must constitute the gauge of that of the drain.

These preliminaries having been attended to, begin digging at the *lowest part of the lowest field* first, regulating the depth of the outfall by the laying of the land above. In proceeding up the ascent, the inequalities of the ground must not occasion the same in the drain, as was the case with some of the drains laid in under government instruction; but the bottom of the cutting must be straight up the ascent, allowing the water to take an uninterrupted course to the outfall. This is essential in all drains, on whatever principles in other respects it is intended to construct them; whether for filling up with broken stones or small stones gathered on the land, or box drains, or pipe drains. There is, however, a considerable difference in the form, as well as in the expense, of these different kinds of drains, the pipe drain being by far the cheapest, most durable, and the most efficient; the price of the pipes or tiles being now so much reduced as to render them, all things considered, the most economical material that can be used. And, on the other hand, the machines for manufacturing them are now made upon a scale to meet the requirements of any estate; so that where the proper clay is to be procured they may be manufactured on the spot at a very cheap rate. The following is Mr. Morton's estimate of the expense of making the different sizes of pipe tiles, according to the price of coal:—

Size of bore in inches.	Price of coals per ton	Price of pipes per 1,000.	
	s.	*s.*	*d.*
$1\frac{1}{2}$	5	8	6
,,	10	9	6
,,	15	10	6
,,	20	11	3
2	5	10	0
,,	10	11	8
,,	15	12	6
,,	20	13	9
3	5	17	0
,,	10	18	8
,,	15	20	4
,,	20	22	0

The inch pipe will, of course, be quite as cheap as the inch and a half,* and perhaps rather cheaper; and both Parkes and Denton have found that for a distance of 150 to 300 yards they answer the purpose quite as well as those of larger bore. Beyond that distance it is desirable to increase the size; and in very wet or boggy land to enclose the small tiles within larger ones, to prevent them from silting up with the ferruginous water, which in some cases is very troublesome.

The modern tools for draining enable the workman to carry the cut a sufficient width to within one foot of the bottom, when a smaller spade with the end of the graft the size of the tile is used to finish it. The bottom being then cleared from the crumbs, it is ready for the tiles. Collars are used to receive the ends of the pipes; but latterly the pipes have been made with an enlargement of the bore at one end to receive the small end of the next; and thus the lineal continuation of the drain is preserved regular and unbroken.

The small space between the pipes would lead many persons to suppose that it is impossible for the water to filter through them in sufficient quantity, or in time, to

* Parkes states that the inch pipes may be made on the estate at 4*s.* 6*d.* per 1,000, and even less.

drain a wet piece of land. Experience, however, proves that water will find its way through crevices impervious to the eye, and that it requires only a very minute hole to admit three gallons of water per day, or one pint per hour. Mr. Parkes states that with inch pipes in drains 4 feet deep, and 24 feet asunder, each pipe being a foot long, the quantity of water drawn off in forty-eight hours was six gallons to each lineal foot of drain, allowing one pint per hour for every pair of pipes. "The weight of rain per acre," he says, "that fell during the twelve hours amounted to 108,900 lbs., or about 48½ tons, and, on the whole piece of 9 acres, is equal to 437½ tons; and each drain discharged 19 tons, equal to about four-tenths of a ton per hour, on the mean of forty-eight hours; but when the flow was at the greatest I find that each drain must have discharged at the rate of five times this quantity per hour, which affords proof of the faculty of the pipes to receive and carry off a fall of rain equal to 2½ inches in twelve hours, instead of half an inch—a fall quite unknown in this climate."* This action of tile-drains is facilitated in clay soils by the fissures caused by the drying and cracking of the soil when the water is filtered from it.

The size of the pipe used must, however, be regulated according to the nature of the land, and the quantity of water to be drained off. The small 1 inch and 1½ inch pipes should be laid down with collars, which prevent that irregularity in the position of the pipes at the bottom of the drain, which the clumsiness, or the carelessness, of the workmen would sometimes occasion; but where the pipes are united as we have shown above, the collar is unnecessary, a substitute in that case being made within the pipe at one end. On a mixed or open soil the 1-inch tile will work sometimes 300 yards if the fall is good; but at that distance main drains of larger diameter should be laid down, as they will have to receive the water from many of the minor drains. 2-inch pipes will be amply sufficient for the purpose, and they should be laid across, either at right angles or diagonally, according to the fall, with the minor drains, the water from which they are to receive. If the soil is at all stiff, 200 yards is quite enough for a continuance of such pipes; and, if the fall admits of it, it may be continued 200 yards more with 1¼ or 1⅜ pipes; after which, if the outfall is not reached, the 2-inch pipes may be used to the end. If, again, the land is infested with springs, it will require a larger than a 1-inch pipe to carry off the water.

There are some spots on the declivities of hills where there is a constant flow of water in the subsoil, which renders the lands below springy and boggy. In such cases, Parkes recommends laying two 2-inch pipes side by side, and a third above them. When the springs are high, all the pipes will run; whilst when they are low only the two lower will work.

In mountainous countries, where the fall is great, and the descent of water in a heavy rain rapid, open drains are preferable to under drains. In Scotland, these are usually dug on the sheep pastures of the eastern mountains, from 12 to 16 inches deep, 12 inches wide at the top and 6 inches at the bottom, and with a distance of from 6 to 9 yards from each other. They are laid in the direction of the steepest part of the mountain, and the soil taken from the drains is spread on the surface of the intervals, in order not to break down the edge of the cutting, whilst on the other hand the mould will be beneficial to the pasture. Main drains are laid across them at short distances, to prevent them from washing deeper by the increasing rush of water after a heavy rain.

* Parkes' "Philosophy of Draining," p. 44.

These main drains are sometimes made available for irrigating the low grounds at the foot of the mountain in a dry season. Reservoirs are also made to supply the sheep with water, which they greatly require to keep them in health. An idea formerly prevailed that it was improper for sheep to have access to water, under the supposition that it produces the rot; but this idea is now exploded, and it is well understood that all ruminating animals require much water. On the mountain side the main drains should cross the others in an oblique direction, with a gradient of 1 in 30.

Many of the hill pastures of Argyleshire have been increased in value 500 per cent. by draining, and the general health of the population, as well as of the sheep and cattle, is much improved. The removal of the stagnant water has broken up the nursery of myriads of flies and other insects that annoyed and injured the sheep and cattle. In a paper drawn up and presented to the Highland and Agricultural Society, by Mr. Lawson, of Argyleshire, in 1860, on the drainage of hill sheep-farms, he says:— "In all cases of drainage, I have found a continuous accession of drains more useful than what is called a full course of drains, put in at distant intervals; and land that has been once drained on a proper principle should never be allowed to retrograde, it being always much easier to retain a good herbage than to renew it when injured. A gradual drainage is safest, as it enables the operator to attain the proper water level, and thereby avoid possible injury by over-draining. The general health of sheep is much improved by keeping their pastures judiciously drained; they will be maintained in a more uniform condition, their size will be increased, and their wool will be improved in quality, although it may not be increased in quantity."*

In draining bog land, Mr. Parkes recommends ramming sods from the surface hard at the bottom of the drain; then laying the pipes upon it, and ramming more sods over them. Such drains have been found to be always running. Some peat-drains—that is, drains formed with peat-sods—have been discovered 100 years old, that were as good as on the day they were laid in.

There are some lands so locked in by higher land on every side that it is impossible to obtain a fall or outlet for the water, and such lands have usually been condemned as incurable. In some such cases, recourse has been had to what are termed "swallow-holes;" these are holes dug deep into the ground, to reach the water-level, or a sandy, gravelly, or chalky subsoil. Into these holes the drains are all made to discharge their water, which is swallowed up speedily by the absorption of the subsoil. In some of the counties round London, where the soil overlies the chalk, these swallow-holes have been found perfectly effective to carry off all the water falling on such land-locked fields. Parkes speaks of land in Surrey that was so soddened with water that, before being drained, it never produced more than 12 bushels of wheat per acre, and in one case, with that quantity, there were 4 bushels of May-weed seed. The first year after being drained, the yield was 48 bushels of wheat per acre, and the May-weed had nearly disappeared.

The fact is, many of these wet and unprofitable lands turn out the best and most profitable, when drained and subsoiled. When once this latter operation has been performed upon a clay soil the clay never closes again as before, but continues accessible to the water, and thus facilitates its escape downwards to the drains. Draining acts both mechanically and chemically. Mechanically, by removing the excess of water

* "Report on the Drainage of Hill Sheep-farms."—(Journal of Agriculture for 1860.)

from the soil, and thus assisting the operations of husbandry and lessening the expense of tillage; and it is estimated that the saving of horse-power by drainage amounts to 25 per cent. The land also may be laid upon the flat without any furrows after thorough draining, by which a considerable saving of land is effected.

The chemical effects of drainage are:—The admission of air into the soil; the facility it offers to the earth to attract and retain the elements of fertility, brought to it by the rain, in a healthy state for assimilation by the plants; the absorption of the night dews in summer, which impart warmth to the soil; the more speedy decomposition of manure and its assimilation by the plants; in the prevention of the miasmata arising from the stagnant water, which is productive of fever in various forms in animals, and of fungi and insects destructive of vegetation.

There are few parts of the country now that are not situated near a railway, by which they can obtain draining tiles at a moderate price. Wherever this is the case, it would be folly to lay in stone drains, although the stones may be had for picking up. The expense of collecting, carting, digging the trenches, and putting in the stones, is far greater than that of laying down pipe-tiles. The difference is estimated at 30 per cent., whilst the durability of the tiles is much more certain, the stone drains being liable to choke up with sediment and roots of plants. If the pipe drain has a fair fall, and a full flow of water after rain, it will keep itself clear from silth. This is one reason for having the small pipes, that they are more likely to keep themselves clear than large ones, in which the flow of water is not sufficient to fill them. It will be seen that this is an important consideration when it is stated that a 2-inch pipe contains a diameter equal to four of a 1-inch pipe. Thus, with a constant fall of 11 feet 8 inches 10 lines, the following has been found to be the graduated flow of water in cubic inches per minute*:—

1st. Through a horizontal circular orifice of ½ inch diameter	2,311 cubic inches.
2nd. Through ditto 1 inch diameter	9,281 ,,
3rd. Through ditto 2 inches diameter	37,203 ,,

And with a constant fall of 4 feet the flow was:—

1st. Through a lateral circular orifice of ½ inch diameter	1,353 cubic inches.
2nd. Through ditto of 1 inch diameter	5,436 ,,

It will be seen that in proportion to the height of the fall of the water, the flow will increase or diminish, the quantities of water discharged in the same time through the same aperture under different heights of the surface in the reservoirs, being to each other nearly as the square roots of the corresponding heights of the water of the reservoir above the centre of the aperture. The friction also is greater in a small

* See Gregory's "Economy of Nature," vol. ii. p. 487. About seventy years since, the Commissioners of the New River Company were in treaty for an increase of water from the Lea River at Ware. They had previously had a 12-inch pipe to connect the two water-courses, and it was proposed to double the quantity by having *another pipe of the same dimensions*. The lawyer or engineer employed by the New River Company was a shrewd man, and he soon perceived that the authorities of the Lea River knew nothing of the science of hydraulics. After some fencing, he remarked that the treating for two pipes would occasion a great deal of additional writing and unnecessary expense. Would it not be better to have one 2-feet pipe, instead of two of 12 inches each? The Commissioners of the Lea River at once agreed to this apparently very simple arrangement, nor did they discover their error until after the deed was executed. The difference was *two feet*; that is, the New River Company obtained 4 instead of 2 feet of water, the area of a circle being as the square of its diameter.

than in a large aperture; it thus admits less water in proportion. The resistance, therefore, to the flow of the water is greater, and, consequently, the danger of stopping up would be less in proportion to the obstructions presented to it.

Marshy and swampy waters owe their origin to springs proceeding from high grounds; and as the soil of the land at the foot of such elevated tracts is generally of a spongy nature, and level, the water, for want of an adequate outfall, pervades the whole mass. In these cases it is necessary to find the source, and this usually lies on the brow of a hill overhanging the marsh, and forms the point or apex of an angle, with the marsh as its base. A drain cut from this point, of adequate depth, and left either open or laid with pipe-tiles of a size proportioned to the flow of water, will draw it off; and the supply being thus intercepted, the marsh will soon become dry and sound. Open drains, in such cases, are most desirable for a time, until the quantity of water diminishes, when pipes may be safely laid in, of a diameter adequate to the quantity of water that is to flow through them. They must be led to the lowest outfall that can be procured, and in the most direct manner. When the marsh has been laid dry, and become sound, under drains may be put in, being required for carrying off the rain-water in a wet season.

The benefits derived from drainage are very numerous. By it the temperature of the soil is raised, as well as that of the subsoil. This is especially the case with the closer clay soils, which are most impervious to the atmosphere when in a state of nature. This is easily accounted for. While the water is retained in the land, the atmospheric air has no power to enter it, and it remains in a cold and ungenial state. But as soon as provision is made for the discharge of the stagnant water, the pores of the soil being left open, the air enters there and permeates the whole mass. Cold being a *nonentity*, and only an indication of the absence of heat, *which is a substance*, the entrance of the atmospheric air, which has been warmed by the sun's rays, fills up the vacuum left by the retiring water. The *Gardener's Chronicle* states that a garden in Hampshire having been drained $4\frac{1}{2}$ feet deep, the temperature of the soil (a heavy clay) was raised by it 15°, and that temperature is retained as long as the drains work. The advantages arising from this to the growing crops are too obvious to need enumerating. Quickness of germination and vigorous growth in all the after progress of the plants are the results; and if the harvest be not hastened by it, it is because the plants exert a greater amount of vegetating power, which prolongs their existence. The same cause, however, more perfectly matures the grain and more completely fills the ear, and the whole crop ripens uniformly. These advantages are increased when draining is coupled with deep tillage or subsoiling. The straw of drained land is better for cattle fodder; the green crops are more succulent and nutritive; the natural grasses are stronger, thicker, and heavier, and, in short, all kinds of crops exhibit the good effects in their healthy and vigorous appearance.

The decrease of actual exertion to both man and horses in ploughing and other tillage operations, is another advantage of draining. The land, being equally dry throughout, is worked with far more ease, and to a greater depth than can be effected on undrained land. Instead of the furrow-slice being turned over, in a clay soil especially, in a clung unbroken mass, it crumbles under the plough; and in spring-time the drained land is ready for the plough a fortnight or three weeks before that which is undrained. The harrows, too, perform their office with more ease and celerity.

However wet, from recent rain, the soil may be, the moisture does not remain in it, and it becomes ready for the harrow in much less time, because its aeration is more quickly and more completely effected, which renders it friable and easy of comminution.

The effect of drainage upon live stock is equally beneficial. The temperature of the soil being warmer, they have a more comfortable resting-place to lie on by day and night, drier and warmer standing for their feet, a more healthy air to breathe in, and more nourishing food to eat. They fatten faster because they are more at their ease; and their flesh is of a finer quality. These benefits are more palpable in sheep stock than in larger cattle. Lands that, undrained, could never be stocked with sheep, because of the rot and the foot-rot, have been rendered perfectly innoxious by thorough-draining, so that sheep could be fed upon them at any time with perfect impunity.

The same cause that operates to lead the water to the pipes of a 4-feet drain, namely, the *vacuum*, or more properly speaking, the space filled with air in the pipes, which gives way to the gravitation of the heavier body,—the water,—causes also the aeration of the soil, in order to fill up the spaces left by the retiring water. We have said before, that "nature abhors a vacuum," and she has, therefore, provided for the instant occupation of the vacant cavities by the atmosphere; and this is in turn expelled by the rain-fall, which, again, descends to the drain. And thus, air and moisture, both bringing warmth to the soil, alternately occupy the soil and subsoil, imparting health and vigour to vegetation; and the warmth thus admitted extends to the same depth as the drain, although probably not in the same degree as that near the surface, heat not being received in the earth by radiation, but by contact with a heated body. And the rain-fall and air having communicated the greatest part of their heat in passing downwards, the proportion received by the soil at the depth of 4 feet, must necessarily be much less than that accruing to the soil near the surface.

Capillarity is a faculty in the earth by which it draws the water upwards from the water-bed; and it would appear that this faculty is increased by drainage. It is supposed that this is effected by evaporation, superinduced by the increased temperature of the soil. But as the temperature at the depth of 4 feet does not exceed from 40° to 44° in undrained land, it can hardly be supposed that evaporation could be promoted by it to the extent to which moisture is supplied to the soil in dry weather. We have already shown that the atmosphere supplies a large portion in the form of dew; and the fissures caused in the earth by drainage increase the capillary power of the soil, overcoming even that of gravitation.

The best evidence, however, of the value of drainage is to be found in the increase of produce, and the increased value of the land, both to the owner and the occupier. By it, bad land has been converted into good; it has turned an enemy to the farmer (water) into his best friend; because whilst it relieves the land from stagnant water at all times, it provides for a sufficient and regular supply when most needed; it lightens the labour while it increases the facilities of husbandry, so that both man and horses are enabled to work with more comfort; and, lastly, it renders a once sickly country healthy both for man and animals, and thereby promotes both the comfort and longevity of the labourer, and the utility and profitableness of the cattle. The profits of drainage must vary with the nature of the soil; but we do not know of any soil, capable of cultivation at all, that will not be benefited by it, if, at the same time, cultivated with judgment. Some lands pay cent. per cent. per annum for draining, while others do not give more than from 15 to 50 per cent. upon the outlay. One thing, however, is certain—that we have no record of land having been injured by draining, if properly done, or even of land that has not, to a greater or less extent, been benefited by it.

SECTION III.

ARTERIAL, OR MAIN DRAINAGE.

The subject of Arterial Drainage has been a good deal discussed the last few years, since the practice of under-draining has become established, it having been found that, in a multitude of cases, the land cannot be effectually drained on account of the obstructions existing in the rivers and streams throughout the country. These obstructions are of various kinds, arising, to a considerable extent, from the beds of rivers requiring to be lowered and straightened; but chiefly from the existence of water-mills, weirs, dams, and other artificial works, which, owing to the vested interests claimed by the proprietors, could not hitherto be interfered with or removed, without the intervention of an act of Parliament, the expense of which, heavy in all cases, might be increased indefinitely by the opposition of parties concerned. It is estimated that some millions of acres of the finest land in the kingdom are, by such obstructions, kept in an unimproved state, not producing more than half the crops of grass or corn they otherwise would, and, in many instances, rendering whole districts unhealthy by the constant presence of stagnant water.

In the session of Parliament of 1861, an act was passed for the express purpose of enabling the owners of such lands "to remove mills, dams, weirs, and other impediments which at present impede the upland waters in their passage to the main arteries or outfalls, upon payment of due compensation." Two-thirds *in extent* of any injured district may oblige the remaining one-third to join in the expense of getting rid of those obstructions; and where it is necessary to straighten and deepen old rivers or water-courses, and to make new cuts, compulsory powers of purchasing land are given. One-tenth of a district may originate the measure, and it requires more than one-third to *express dissent* before the project can be rejected, if it is approved by the Enclosure Commissioners. The bill consists of three parts, the two first of which embrace district drainage, as stated above. The third part refers to outfall works, such as easements for the passage of drainage-waters through the land of lower owners, and the deepening and straightening of water-courses. Thus, the owner of land lying high can carry his drainage-water through his neighbour's land below, and, with the consent of the justices, deepen the water-courses, or even cut new ones, if necessary. This right, however, is liable to an opposition which, if the opponents are litigious, may be rendered very expensive; the fear alone of which will doubtless deter many persons from undertaking a measure of the kind. This is considered to have been an oversight of the framers of the bill, which throws all the expense of the opposition upon the party proposing the measure, and also where it is adopted and carried into effect, whatever it may cost, although the party through whose land the water-course passes may be as much, or even more, benefited than the original proposer. It is most probable that these defects in the bill will be remedied at an early period, so as to give it the fullest scope, and enable the owners and occupiers of land to improve it by drainage, and thus increase the produce.

It is impossible to estimate the quantity of land that is thus, in a manner, water-logged by obstructions; but in some parts of the country, where there are a great number of small streams springing from the high grounds, there are small mills almost in every mile of the water-course. It is not only the land lying immediately on the banks of a river that is injured by the obstruction of a mill, the adjoining upland arable fields are frequently prevented from being effectually drained by the same causes. This is especially the case where a tract of land belonging to a miller intervenes between the property whose owner desires to under-drain and the river. In such instances it was impossible for the improvement to take place; for such was the jealousy of the miller with respect to his vested rights over the water-course, that he would refuse all arrangement for the conveyance of the drainage-water through his property, because it must have its outlet *below* the mill, and thus be lost to the mill-head. This, indeed, is a matter of very frequent occurrence, for it is always an object of considerable importance for a miller to possess land adjoining the stream, in order to secure the flow of the water-courses from the adjoining land, and prevent it, as far as possible, from being alienated and carried below the mill. Water millers generally consider the uplands as the reservoirs of their streams, and look upon every acre of land drained as so much taken from their just rights; they therefore strenuously oppose any infringement upon their claim to the entire water-way as an attack upon their private property.

With regard to the effect of arterial drainage, both upon the land and the mills, we are not without decisive evidence that while the one is greatly increased in value, the other frequently receives a collateral benefit. We shall first state the case of Ireland, for the arterial drainage of which a general act of Parliament was passed a few years back, and to a certain extent was carried out under the superintendence of the Commissioners of Public Works. The rivers operated upon pass through the counties of Westmeath, King's County, Clare, Galway, Limerick, Meath, Cavan, Longford, Leitrim, and Roscommon; and it is estimated that, with their tributaries, they extend nearly 400 miles, and that the outlets provided for the escape of the water, relieved the catchment-basins over an area of 7,000,000 acres, a considerable portion of which was laid dry enough for cultivation, and the under-drainage of the remainder was for the first time rendered possible. Up to the year 1852 there had been effectually drained 332,000 acres, of which 192,000 were previously constantly liable to be flooded after heavy rain, and a considerable portion was actually under water. Thus, in a very few years, 11,000 square miles, or nearly one-third of the entire area of Ireland, was rendered capable of improvement, and a large extent of land was actually brought under immediate and highly-profitable cultivation at an expense of £1,370,760 sterling, or an average of £4 2*s.* 6*d.* per acre, including the charge of building bridges, weirs, masonry, the purchase of mills for removal, and the improving the water-power of those that were allowed to remain. Thus, in the district of Dunkellin, four mills, with their buildings and machinery, were removed, and, with their sites, were paid for at a valuation, whilst several others had their mill-races lowered, which required the sites and water-wheels also to be lowered. In such cases, the tail-stream was deepened more than the dam, in order to increase the fall, and with it, the water-power. The drainage of the Dunkellin district, including the purchase, &c., of the mills, did not average more than £2 16*s.* 6*d.* per acre.

But the most successful case was that of the Castlenode and Strokestown district, a large portion of which was so saturated with water and worthless, that the tenants had, by tacit permission, held it for sixty years rent free, by which, in fact, they had become *proprietors-in-fee*. So completely and beneficially was the drainage of the district effected, that the land has since let readily, on *Con-acre,* at £6 10*s.* per acre. In the neighbourhood of Longford, also, a similar tract of water-logged country was perfectly drained, so that the *increase* of the crops, *the very first year,* paid the whole expense. The success of the measure in Ireland may be ascribed to its being executed under a general act of Parliament, the entire law-costs for 122 districts amounting to little more than £1,000; whereas, if local acts had been obtained for each district, it is probable that each would have cost nearly as much; whilst it is a question whether the work would have been executed so effectually.

From the case of Ireland, we shall turn to that of the "Wye and Derwent" drainage in Yorkshire, for which a local act of Parliament was obtained a few years since. Under this act 27,000 acres were improved at a public outlay of £30,000, two-thirds of which sum, or £20,000, was paid to three millers for their water-power. The Vale of Pickering was the district on which this was effected, and it covers an area of 160 square miles. It is traversed from its upper end by the rivers Wye and Derwent, which, after a separate course of forty miles, form a junction at about the middle of the valley. Each of these receives a number of tributaries, and after their junction, discharge their waters into the Ouse, meeting the tidal water of the Humber about twenty-seven miles below Malton, being thirty miles from their junction. Under the act, the mills were removed, the shallows were lowered, the courses of the rivers were straightened, and all the tributaries were opened and lowered, to give a full discharge for the water. The late Mr. Pusey stated, that he has known one flood do more damage to the crops and land of that valley, than the amount of whole sum expended on the works; and that when the fall of rain in 1852-3 took place, the water never rose to within *five feet* of the former level of a high flood.

We have stated these cases for the purpose of showing that where the system of artificial drainage has been carried out in a proper and economical manner, it has been attended with the most beneficial results, and has given the greatest satisfaction to both landowners and tenant-farmers. The latter case, although executed under a local act, was not attended with an expense at all adequate to the benefit derived from it. The general act of the session of 1861 will render a local act unnecessary, which will materially reduce the expense of any future case of arterial drainage. That such operations are needed throughout the country, is now acknowledged by every person capable of understanding the subject. Nearly all the rivers of England and Wales are encumbered with mills, and in some counties they occur at very short intervals. In the upper valley of the Nene there are thirty-three mills in a distance of sixty miles. On a small stream in Dorsetshire there are five mills in a distance of four miles. On one in Norfolk there are four and a weir in three miles. In Devonshire there are numerous small streams, with mills at very short distances, wherever a sufficient fall can be obtained. Such, in fact, is the case with almost all the rivers and streams throughout the country; and it would be an endless task to enumerate the thousands of cases in which whole districts are prevented from improvement and rendered unhealthy by the obstructions to drainage created by mills and other erections.

Although the damage by floods is less permanent, it is for the time more palpable and more alarming. In the years 1847, 1848, 1852, and 1853, the damage inflicted by land floods amounted almost, if not quite, to as much as the arterial drainage of the whole kingdom would amount to, a great part of which would have been saved to the country had the system been previously carried into effect. Not only was property to the value of millions sterling actually destroyed in each of those years, by the rising of the water in the rivers, and the flooding of the lands on their banks, but the loss of crops, both from inability to sow the land, and deficiency of crop in those which were sown amounted, by estimation, to 10,000,000 quarters of wheat in 1853 alone; and it was only those lands that were thorough drained, and had a good outfall for the water, that were successfully sown that season. Nor was the injury to public health less severe and alarming. In those parts of the country where the water stagnated for want of drainage, epidemic disease fearfully prevailed. That the cause we have assigned for this is the true one, no medical man will deny. An instance of the effect of drainage on health occurred a few years since on the Duke of Bedford's property at Cople. Owing to the swampy condition of the land, typhus fever was almost constantly prevalent in the village. The Duke directed a brook which ran through it to be straightened and deepened, which drained the adjoining land of the stagnant water. The result was that in the following eight years *only one case of typhus* occurred in the parish.

Now that an act of Parliament has passed to meet these evils we may expect that, eventually, as soon as the landed interest becomes alive to the extent of the injury annually sustained, the system of arterial drainage will be universally carried out, and all obstructions to the free outfall of the drainage waters removed. The subject has undergone so much discussion of late that it cannot but be understood. Those cases in which it has been adopted, with one exception, have succeeded beyond expectation, and have more than repaid the outlay. On the other hand, the losses sustained the last sixteen or eighteen years by floods and excessive moisture, owing to the stoppage of the course of rivers and brooks, have been fearful. Could they be accurately estimated, the amount would be found to be sufficient to pay the expense of regulating every river in the kingdom twice over. In the year 1852-3, the destruction of agricultural produce, both animal and vegetable, amounted to many millions sterling, and the loss of the succeeding crop of wheat, from inability to sow the land, occasioned an outlay of at least £25,000,000 sterling to the country. A great proportion of the loss in either of these modes would have been avoided had an arterial system of drainage been previously carried out.

But the injury arising from the damming up of the rivers is not confined to the actual and occasional destruction of crops. The hindrance it causes to under-draining extends to millions of acres, which are thereby rendered only half productive, and certainly unhealthy, both to man and beast. The injury sustained by this is beyond the reach of calculation; but it is both large and permanent, and thus becomes one of the most important parts of the subject. Looking, in fact, at the question in whichever way we may, it appears impossible that it should remain much longer in abeyance; for until it is seriously and generally taken up by the landed interest, the lands of England will never yield their maximum of produce, nor can the necessary permanent improvements be effected. "The farmer," says a late writer, "may design deep draining, the sanitary reformer attempt to remove *miasmata*, the machine may pour forth its countless pipes and tiles, and the national loans may contribute to putting them into the ground; but all is of little use unless you procure previously a sufficient outfall."

SECTION IV.

FENCING.

This section carries us back to the period when the land was divided into *Infield* and *Outfield*—the first being that part of an estate lying round the manor-house; the last, that which was at a distance. The infield land, which usually received all the manure of the farm-yard, was fenced in, either with live hedges or stone walls, whilst the outfield was without any fences. Being let to serfs, it was divided by balks of grass-land, and was generally common to all the free or copyholders of the parish when the crops were harvested. The live fences round the infield land were allowed to grow high and broad, so as to overshadow a considerable portion of the land; and had, besides, wide grass borders on each side, the harbour of weeds and vermin of every kind. They generally consisted of whitethorn, blackthorn, holly, furze, broom, beech, witch elm, and other low-growing shrubs and trees, with oaks and other large trees at intervals. The fields were generally small enclosures, the nearest to the house being pastures for the cows kept on the farm. We may trace the origin of the *Ring-fence* to this period, it being necessary to protect the infield land, constituting the domain, from the cattle of the outfield tenants after the crops were taken off. The stone, or dead, fences were generally about 5 or 6 feet high, and built of round pebbles, where these could be obtained, but sometimes of brick or hewn stone, if a quarry existed on the estate. In Ireland, the domains of the gentry are still surrounded with stone walls 8 or 9 feet high, built at a period of history when such a safeguard to the mansion was more required than it now is.

The outfield lands remained secondary in point of importance to the proprietors of estates until a late period of the last century, when a desire for their inclosure began to be manifested amongst the proprietors. In the acts of Parliament obtained for the purpose, the common lands were included, and the whole, both of this and the *Lammas*, or half-year land, being thrown into one mass, were divided according to the claims of each individual. Fences were raised round them, and these generally consisted, as at present, of hedge and ditch, with a row of whitethorn (or hawthorn) on the breast of the bank of earth. The fault of the old fences was, that they were planted too high up the bank, which, itself, was unnecessarily so. This occasioned the mould in time to fall away from the roots, especially if the land was infested with rabbits and other burrowing vermin. We may still see vestiges of the ancient fences in some of the backward counties of England, having borders covered with scrub, in some cases reaching 5 or 6 yards into the field. Such are to be found in Sussex, Devonshire, and other parts, and are an indication of the need of the schoolmaster amongst either the owners or the tenants of the land.

Widely different ideas now prevail on the subject. The construction of modern fences is managed with the design of admitting, instead of excluding, light and air into the field. With this view the bank of earth is raised with a slope from the top of not more than 3 feet, surmounted with a dead hedge of bush-thorns, or of posts and rails. The live fence is always kept clipped to the height of the bank, and thus offers no obstruction to the current of air. We shall go more into a description of the mode of raising these fences, which, however, vary in the shrubs employed in their construction.

If it is intended to raise new fences on a farm to any extent, it is the cheapest plan to grow the whitethorn plants (or whatever is used) on the spot, it being expensive to purchase them. In this case, procure the seed of a respectable seedsman; or gather them on the estate, which is better. When you have got a sufficient quantity of the haws, lay them on a heap 2 feet high, with some fine rich loam, and cover them over with the same, in a similar manner as you would a hoard of potatoes, beating the mould on the face of the heap hard and smooth, to prevent the wet from getting in. They must be left thus until the spring, that the fleshy part of the haws may decay and mix with the loam.

The seeds of the whitethorn (*Cratægus oxycantha*) will not vegetate the first spring, and must therefore be kept until the next. Some people give the haws to their pigs or fowls, who digest the soft part, and void the seed whole. The excrement is then carefully saved, and laid on a heap, to become thoroughly rotten, when it is mixed with fine mould, ready to be sown.

Select a rich loam, perfectly clean and well pulverised. Draw drills in it with a hoe, 3 or 4 inches deep and 6 inches asunder. In these put the seed at the rate of half a peck of seed with the mould to every 20 yards. As soon as the plants are above ground, hoe the ground, both to loosen it and to destroy the weeds. The next time they must be hand-weeded by women and girls, and thus kept clean throughout the summer. In the following spring prepare another piece of rich ground, and transplant them into it before they begin to show the buds. In this case, they must be planted from 7 to 9 inches asunder, and the same distance between the rows. Lord Kames recommends not planting the quick until it is five years old, having been kept trimmed yearly, to strengthen and render the plants bushy. But it is difficult to purchase plants of that age, and superior treatment on the seed-bed will bring them forward in four years, fit for planting.

In trimming the banks of old hedges, there are frequently a great number of roots of the whitethorn cut off with the spade. These, if planted, will throw out shoots in the spring, and produce as good fences as seedling plants. Any one, by examining the back of a quickset hedge that has been cut or pared down, may see the ends of roots thus sprouting in the following summer; and if permitted to remain, they will produce a second fence. If not wanted, or not sufficiently numerous, for a new fence, they will be very useful in repairing the breaches in the old ones.

Having procured your whitethorn plants, the first thing is to arrange the direction of the fences, supposing the land is to be laid out anew. It is desirable, on every account, that they should run parallel east and west with the cross fences at right angles with them; that is, north and south. The ridges will of course be in line with the cross fences, north and south, in order to receive the benefit of the sun on both sides.

There are several ways of forming the hedges and planting the live fence. Some plant them on the levelled surface of a low bank, having a shallow ditch on each side, and the quick protected by a double row of posts and rails from the cattle and sheep; others raise a bank, and plant the quick on the face, a short distance above the level ground, surmounting the bank with a dead hedge of thorns, which are also placed on the face of the bank, over the young plants, in a rough manner, to keep sheep, &c., from cropping them. These are the most common and approved methods at present practised of raising live fences, although Forsyth reckons no less than forty-three kinds of live and dead fences, dividing them into simple and compound fences. We shall describe the above two methods as at present practised.*

1st. The direction of the new fence being determined on, the line should be staked out, both in its length and width. If the land is under grass, and there is time for it, a previous summer fallowing should be given it, in order to have the flag well rotted and the land deeply pulverised. It has been usual to lay the young plants upon the upturned flag, without any previous preparation; but this plan has latterly been abandoned, as tending to encourage the growth of grass and weeds amongst them, which occasions both trouble and expense afterwards. Some rotten dung should be trenched in along the line of the intended planting, which will greatly encourage the sets. Another improvement has recently been introduced in the construction of live fences, namely, laying in a drain of $1\frac{1}{2}$-inch pipes and collars, at the depth of 4 feet, *immediately under* the line in which the plants are to be put in. This plan was successfully carried out by Mr. Tait, land steward to the Right Hon. Sir George Clerk, of Penicuik, Bart. The field had been previously drained 4 feet deep, and 9 yards between the drains; and the *hedge drain* was dug half way between the field drains. To test the efficiency of the plan, one half the line of fence was trenched 5 feet wide without a drain. A bed for the plants was prepared, and they were put in on the 12th of April, 1858, and the following November were cut down to the height of from 5 to 6 inches. The following October, the difference between the drained and undrained portions, in length and thickness of the shoots, was very considerable, the former being by far the strongest and longest, and having sent out shoots from the bottom to the top of the stem, whilst those of the latter all sprung from the top. It should be stated that the drained part was planted on the level, or nearly so, whilst the undrained was made on the old plan of hedge and ditch; so the expense per rod of this latter was the greatest, the drained

* Stephens states that in Norfolk they raise a bank 8 feet high from the bottom of the ditch, and plant the whitethorn *on the top!* Being an old Norfolk farmer, I can state that this is not now the case, and that I have never seen a modern fence in that county raised in that absurd manner, nor the quick *planted on the top*, except as I am about to describe. It was certainly the practice to make the fences high in Norfolk in Arthur Young's time, when the breed of sheep peculiar to that county was generally kept, as nothing but a 5-feet live fence would stop them. Since that breed of sheep has disappeared the high fences have given place to low ones, as will be described.—S. C.

being 2*s.* 1½*d.*, and the undrained 2*s.* 5½*d.* per rod. Mr. Tait remarks: "In summing up the advantages of this method, it may be reasonably expected that the plant will have a more equal supply of moisture. Even in a dry season, the air passing up the pipe, and acting with that of the atmosphere above, will cause moisture to circulate through the soil by capillary attraction. The roots, by the trenching, have an increased space to seek for nourishment. Moreover, a saving, as has been already stated, is obtained in the drainage of the field, and less ground occupied than by the old method of hedge and ditch. From the equalisation of temperature thus produced in the soil, the plant will be more vigorous in the spring, and better enabled to send out strong and healthy shoots." We have given the above statement as worthy of the attention of the reader, being another proof of the successful applicability of draining for every kind of plant, whether on the field, the fence, or the forest.

Having prepared the land by previous trenching, &c., a bed should be raised about a foot high, and 2 feet wide on the top. On this plant a double row of whitethorn sets, cutting them down to about 6 inches from the root with a sharp knife with a hooked blade, similar to the gardener's pruning-knife. They must be protected with posts and rails on each side, and kept perfectly clean and free from weeds. The soil on each side may be pared down to the bank and sown with grass seeds (if the field is in grass), so that no land is lost except that on which the whitethorn is planted. These should be kept clipped and trimmed annually, which causes them to grow thick and impenetrable to cattle or sheep, whilst the hedge presents little obstruction to the free circulation of air. The ditch, also, is not required where the land is thorough drained.

2nd. The "hedge and ditch" fence is the most common in England. The line of the proposed fence should be prepared for this, as well, and in the same manner, as for the former, namely, by deep trenching and manuring. The width of the ditch should be set out with a line on an iron reel, and marked with the spade. One spit of earth is then dug a few inches from the line, and laid on the part that is to form the bank. This is to be the bed for the plants, and should be beaten smooth in front, and sloped down to an angle of about 45° with the surface of the soil under the bank. The plants having been cut down to about 6 inches, must then be laid on the mould, with the roots somewhat lower than the stems. The earth from the ditch is then thrown upon the bank, the face of which is from time to time beaten smooth and hard. The same angle at which the bank is raised is preserved in sinking the ditch on either side, the bottom being kept about a foot wide, and each side cut smooth down. When the face of the bank is raised the proper height, that is, from 2 feet 6 inches to 3 feet, it must be backed up with the loose mould that is fallen over, and a few spadesful of earth from the soil at the foot. The whole is usually surmounted by a dead hedge of thorns or other material, cut about 2 feet long, and banked in with the mould at the back. Sometimes a double row of whitethorn is planted on these hedges as well as on the former ones. In that case, the second row must be laid in about 6 inches above the first row. It is essential to the future success of this description of fence that it should be kept perfectly clear from weeds, and that both the face and the back should be looked to annually, that any breaches may be repaired, where made by game or cattle, or the reckless mischief of the huntsman. It is becoming more and more the practice to keep hedges of all descriptions low by trimming them with the shears; by which means, if they are carefully attended to the first few years, they become perfectly impenetrable to cattle, and almost to hares. Besides, by keeping them low, the air circulates more freely, to the benefit of vegetation.

Many farmers plant the quick as close as 4 inches from plant to plant. This is much too near, and 9 or 12 inches will secure a better and more durable fence. When planted closer, a great number die out after a few years, irregularly, so that ugly breaches appear in the fence. The late Mr. Bakewell gave each plant 18 inches, and by carefully attending to them afterwards, never failed to obtain a good and durable fence. The quick should be cut down to about 1 foot the fourth year, which will cause it to throw out abundance of lateral shoots, forming a good outside surface for the shears. It is the common practice to plant timber trees in the hedges, at short distances; and this is an excellent plan for the landlord, but a bad one for the tenant, at whose expense (in produce) the trees are supported. Ash-trees, especially, are exceedingly injurious. Their roots spread out near the surface to a great distance from the stem, and may be traced in a semicircle of barrenness as far as they extend. The barberry bush, too, should be sedulously excluded from fences; for, whatever naturalists may say against the theory, the fact of their deleterious influence on cereal and other crops, but especially wheat, is undeniable, and speaks for itself wherever the barberry makes its appearance.* Marshall, perhaps, made the closest and most conclusive investigation of the subject of any writer; and although he does not profess to give his own opinion of the cause, he states facts enough to deter any person from knowingly planting the barberry in a hedge, although in other respects it forms an admirable fence.†

3rd. The Ha-ha is a sunken live fence, having a facing of stone or brick, perpendicularly built, whilst the other side is in the sloping position. The quick is planted in a double row at the bottom of the ditch, which is about 3 feet in depth, 5 feet wide at top, and 2 feet or 2 feet 6 inches at bottom. In Scotland, these kind of fences are constructed without any live fences. In England, they are chiefly used in parks and lawns, or pleasure-grounds near the house, in order that the fence should form no

* Marshall makes the following observations on this subject:—"It has long been considered as one of the first of vulgar errors among husbandmen that the barberry plant has a pernicious quality (or rather a mysterious power) of blighting wheat which grows near it. This idea, whether it be erroneous or founded on fact, is nowhere more strongly rooted than among the Norfolk farmers, one of whom mentioning, with a serious countenance, an instance of this malady, I very fashionably laughed at him. He, however, stood firm, and persisted in his being in the right, intimating that, so far from being led from the cause to the effect, he was, in the reverse, led from the effect to the cause; for, observing a stripe of blasted wheat across his close, he traced it back to the hedge, thinking there to have found the enemy; but being disappointed, he crossed the lane into a garden on the opposite side of it, where he found a large barberry bush in the direction in which he had looked for it. The mischief, according to his description, stretched away from this point across the field of wheat, growing broader and fainter (like the tail of a comet) the farther it proceeded from its source. The effect was carried to a greater distance than he had ever observed it before, owing, as he believed, to an opening in the orchard behind it, to the south-west, forming a gut or channel for the wind." . . . . "Being desirous of ascertaining the fact, be it what it may, I have inquired further among intelligent farmers concerning this subject. They are, to a man, decided in their opinion as to the fact, which appears to have been so long established in the minds of principal farmers, that it is now difficult to ascertain it from observation, barberry plants having (of late years especially) been extirpated from hedges with the utmost care and assiduity, &c." He then speaks of several cases related to him by trustworthy farmers of the blighting effects of the barberry on wheat; and in a subsequent part of the minutes gives an account of an experiment he himself made by planting a barberry bush in the middle of a large piece of wheat. The result was, an oval-shaped stripe of blighted wheat round the bush, of a dark livid colour, obvious to persons riding along the road at a considerable distance. The grain in this part was light, taking twenty-four to weigh down ten of the other grains, although the whole crop was thin-bodied.—See vol. ii. of the "Rural Economy of Norfolk," min. 13 and 133.

† The writer has seen the effect equally remarkable on a farm on which he resided in Norfolk.

obstruction to the continuity of the prospect, the quick being kept at a height below the level for that purpose.

4th. In light soils the furze, or whin, is frequently used for a live fence, and although liable to be killed by a severe frost, forms an excellent barrier against cattle, as well as a shelter for sheep in winter. They grow faster than the whitethorn, but do not last so long. They are either grown alone, to form a fence by themselves, or at the back of a whitethorn hedge. In the first case, a bank is raised, 5 or 6 feet in breadth at the top, with a ditch on each side. On the platform thus raised the whin seeds are to be sown tolerably thick, and in two or three years will form a fence against any kind of cattle or sheep. They require to be cut down at three years old, in which case it is better to cut only one side, leaving the other standing until the first has grown again sufficiently to form a fence. In light sandy or gravelly soils, exposed to the cold winds, these fences form an admirable shelter for sheep, for which purpose they have long been in use on the Highlands of Scotland.

5th. Another plan practised in Scotland is to raise a conical mound, without any ditch, and on the top to sow the whin seed. This is protected from the sheep the first three or four years, after which the sheep may be allowed to crop the tips of the branches; and as they can get close to the hedge, it is an excellent shelter in cold weather. The cropping of the young shoots is an advantage rather than an injury to the plants, causing them to send out lateral shoots in abundance, which, in their turn, are cropped, so that the fence is constantly kept close and impervious. Forsyth recommends French seed rather than English, and allows one pound to every forty rods ($5\frac{1}{2}$ yards each). In sowing them a drill should be opened with a spade about two-thirds up the back of the bank, opening it wide with the tool. Put the seed into a quart bottle, in the wooden stopper of which is a hole burnt smooth. Trickle the seed out of this along the drill, covering it with a broom drawn gently along the mouth of the drill, and closing it finally with the back of the spade, but not beating it hard, which would retard the vegetation of the seed.

We have known some cases in which English farmers, following the practice common in France and other parts of the Continent, have planted apple, pear, and other fruit-trees in the fences round their fields. These would certainly be more profitable than timber-trees, if the practice was general. But they form, in cases so isolated, too powerful a temptation to juvenile depredators to allow of much of the fruit being reserved for the farmer. Nor does the injury stop there; for in stealing the fruit,—which, by-the-bye, is never considered robbery,—the fences are broken down and irreparably injured; so that, unless the plan becomes as common as in France, it can never be made to answer or be profitable, and we cannot, therefore, recommend it.

6th. Stone fences are much used in mountainous and hilly countries, where it is difficult to raise live fences on account of the loose crumbling nature of the soil. In Scotland, where stone is abundant, there are different methods of raising them, the most common of which, because the cheapest, is to put the stones together without any cement, merely fitting them in with each other in the most exact manner their form will allow. These should never be built of round stones, as is sometimes practised in Scotland, unless mortar is used to cement them. It is impossible, without it, to form a durable fence. But when built of irregular flints, or stones from a quarry, and by the hands of a skilful workman, they may be made to last many years. In Galloway, they cope such fences with flat stones, laid edgeways across the top of the wall, and close together. When finished, one more stone is inserted, and beaten in with a wooden mallet, which keeps the whole tight together. In other parts they simply cover the top with turf or mud; but this plan is not equal to that described. All dry stone walls should be broader at the base than at the top, and care should be taken to fit the stones to each other as exactly as possible, which greatly adds to the strength of the fence.

7th. In the eastern counties, and other parts near the sea-coast, where round pebbles are plentiful, these are used in building fences, as well as houses and churches; but they are always put together with mortar. They are also raised by degrees, that is, a foot or so is laid the whole length of the wall, and allowed to remain until the mortar is quite dry and hard, when another foot is added, and so on till the required height is attained. Were it not for this precaution, the weight of the stones would bring the whole down. On the other hand, if a part only of *its length* should be raised, the probability would be that the wall would not properly join at the point of union, and thus the whole would be endangered. These pebbles, if properly built up with good mortar, are durable, as is evinced by the number of round Saxon towers to the churches of Norfolk and Suffolk, built entirely, or nearly so, of them.* Clay is sometimes used instead of mortar as a cement, and if properly worked, it answers the purpose, and is durable, but must be erected by degrees. We have seen such fences that have lasted upwards of half a century at least; but good mortar is much preferable.

8th. There are various methods of repairing or renewing live fences of whitethorn. In Norfolk, the most common method is as follows:—The stubs of the whitethorn are cut down "smack-smooth" to the bank in a slanting manner, and then all the grass, weeds, and loose earth are carefully raked or scraped off the face of the bank, and thrown aside on the land. The bank is then repaired from the bottom to the top with fresh earth, dug from the ditch, keeping the butts of the whitethorns clear, so as not to prevent or retard the young shoots in the spring. When the bank is made up the proper height in front, the back must be completed, and a dead hedge set on the top, the same as in forming a new hedge. The whitethorns acquire fresh vigour from the fresh mould, and in two or three seasons will throw out an entirely new live fence. If the stubs have died out or been destroyed by accident, young plants may be substituted, but they do not always succeed, except they are laid in entirely new earth. We have, however, found whitethorn stakes thrust into the bank sometimes take root in a wet season, and fill up the gaps.

9th. Another method of repairing whitethorn fences is by *plashing*, which is performed in the following manner:—The bank is in the first instance made good by fresh earth out of the ditch, the larger of the thorns having been cut out, and the younger and more pliable of the branches left standing. Stakes are then driven into the bank at the distance of 2 feet from each other, and on a line with the live fence.

* A curious discovery was made at a parish church in Kent, the date of the subject of which is referred to the Saxon Heptarchy. On the door of this church was a broad thin substance, which had been painted over so many times that it was impossible, from a cursory view, to judge what it was. An antiquary, however, happening to go down to the village, noticed this patch on the door, and communicating his suspicions of its nature, obtained the rector's consent to take it off. Upon removing the paint, it was found (as he expected) to be a piece of human skin, and was, beyond a doubt, that of one of the Danish invaders, nailed there according to the known practice of the Saxons, in that barbarous age, as a warning to their enemies.

The branches of whitethorn are then wattled between them, with such a proportion of other brushwood as is necessary in order to make the hurdling sufficiently thick and compact. It is finished off by wattling the top with hazel or other pliable and tough branches, which, if well executed, will keep the whole tight and strong as long as the stakes continue sound, when the live fence may be expected to be sufficiently grown to protect the fields from the cattle.

10th. Very old live fences are seldom worth the repairing, and the best and cheapest plan is to throw them down and raise new ones. In this case it will be necessary to let the soil of the destroyed fence remain one season to consolidate, as no young whitethorn or other plant would grow in the exhausted and impoverished earth of an old bank, without its being fallowed. The old stubs, therefore, being grubbed up, the bank should be thrown down and levelled with the field, which, being done in the spring, must remain to the following spring, when the new hedge may be successfully raised. The firewood from the old fence will generally be sufficient to pay the expense of throwing down, whilst that of raising the new one will not so greatly exceed the cost of repairing the old as to make the difference a material object in point of economy. On the other hand, the satisfaction of having a good young fence instead of a broken defective old one, is a material consideration with a farmer who wishes to see his farm complete. In fact, the landlord himself ought, at the beginning of a lease, to bear the expense of putting the fences into repair or renewing them when necessary, although, from the great competition for farms, this is seldom insisted upon.

11th. In raising new fences in lieu of old ones, if the latter are crooked, it will be better not to adhere to the same course, but to run the new one in a straight line from end to end. In some cases this would cause a material deviation from the old line, and probably leave many timber or other trees standing out into the field. These cannot be cut down by a tenant without the consent of the landlord; at the same time they form such an obstruction to the tillage of the field, and do so much injury to the crops, that no landlord who wishes for or consults the welfare of his tenant, would object to their being cut down, although he might stipulate for the planting of others on the new fence.

12th. If a young whitethorn fence grows irregularly, or gets stunted after four or five years, whether from neglect or any other cause, the best plan is to cut it down at once, and, if possible, to insert some rotten dung into the bank above the sets. This will give them a stronger start in the spring following, and they will soon exceed the height and thickness they had before cutting down. We have seen cases in which the shoots of the first year have reached 4 or 5 feet, with many lateral shoots at bottom, forming a good foundation for an impenetrable fence in two or three seasons.

13th. Mr. Morton recommends raising new fences of whitethorn in the autumn; and if we could ensure a mild winter it might be desirable to do so; but in our variable and often cold climate, the spring (say February) appears the best time to conduct the operation, as the young plants will then want no protection, nor will the bank itself suffer dilapidation from the winter's rain and frost before the young quicks have taken a good hold of the soil. A heavy fall of snow, too, is apt to break down the face of a newly-made fence, leaving the roots of the fresh-planted quick exposed to the changes of temperature, if not made good immediately the snow has melted. Hedging in the spring is seldom attended with these inconveniences; and if the bank has been manured, and strong plants selected, the latter will have taken so firm a hold by the next winter, and the bank itself have become so consolidated, that the atmospheric changes will have no, or much less, influence over them. The plants themselves will have lost nothing by the delay in regard to growth; but will, on the contrary, have acquired greater strength of root by being left four months longer in their native soil, the well-known process of all kinds of vegetation during winter; which is wholly lost by planting in the autumn, as the newly-planted quick lie perfectly quiescent until the spring.

14th. In Devonshire a different mode of planting live fences is pursued. Two walls are built a few feet from each other, and the interval is filled up with earth, on which is planted the whitethorn, or whatever other plant is used. In other cases a stone wall, $2\frac{1}{2}$ feet high, is built on the top of the bank of earth thrown out of the ditch, having the quick planted in front of it, the wall being surmounted with a turf coping. In others, holes are left in a stone wall, built 3 feet high on the bare ground, the bank being raised at the back. The whitethorn is planted so that the stems protrude through the holes, which are about 2 feet from the ground. As the thorns grow, it is supposed that they protect the wall above them from falling; but it is more likely that, before they become strong enough to afford any support, the stones may have slipped and borne down the plants, and thus irremediably injured the fence. Other plans, equally or more fallacious, for erecting fences of part stone and part whitethorn are practised where stone is cheap; but it would seem to be an unnecessary expense to unite the two, when the stone wall alone, if properly raised, is sufficient for all the purposes of a fence.

15th. Other plants besides the hawthorn are used in raising fences, the best of which are the holly, the blackthorn, the beech, the crab, the hornbeam, &c. The holly (*Ilex aquifolium*) is a slow-growing shrub, but, if carefully attended to, makes in a few years an impenetrable fence. They are the most expensive of any plant, requiring to be kept on the seed-bed two years; then planted in a nursery-bed four more, and then again transplanted for two years more, before they are strong enough to be planted out for a fence. The ground must be trenched and manured along the line of the proposed fence, and the soil rendered as fine as possible. Mark out the ground with a garden line, and with a spade open a hole large enough to receive the roots of the plant. Step backwards, and open another hole at 1 foot distance from the first, using the second spadeful of earth to cover the first plant. In this way, proceed backward until the whole line is finished. Then tread them carefully firm and upright. The whole line must be protected with a double post-and-rail fence, until it is high enough to form a fence, when the dead fence may be removed. The plants should be kept clear from weeds, and no pruning allowed the two first seasons; after which any irregular shoots may be trimmed off, but the leading shoots must be left to reach the required height before they are touched. July is the best month for trimming the holly with the shears, as the after-shoots cover the blemishes the tool has made in the foliage. The first trimming should be done with a gardener's pruning-knife, as there will be few shoots to cut off, and the knife makes no blemishes, nor takes off more than is requisite to render the fence level. If the plants have been stunted by neglect or a dry season, the first year of planting, it will be the best way to cut them down to the ground, as they will then spring up strong again, and make much greater progress than if they were left to recover from their stunted condition. The holly hedge may be trimmed into any desired shape; and it was formerly the custom, near the old manor-houses, to cut them into all kinds of fantastical forms, such as peacocks, men and women, fountains, vases, &c. &c., some of which may still be seen in secluded situations where the residents make a point of keeping up all the old traditions and practices of the manor. The holly hedge, being planted on the level ground, takes up less room than any other, if kept properly trimmed, and forms the most durable and effective fence. It is, however, chiefly confined, in its use, to the park, pleasure-ground, and garden, on account of the slowness of its growth and the expense attending its first ten or twelve years. It is, notwithstanding, frequently mixed with the hawthorn in new fences, and makes a pleasing variety in their appearance. No shrub is equal to it, either in durability, closeness of texture, appearance, or safety from injury. No animal will eat it, nor, when well trimmed, be able to penetrate it; while it affords them admirable shelter from the storm at all seasons of the year.

16th. In raising the plants of holly from seed, the berries should be gathered in December, and laid in a heap for the fleshy part to rot, turning them often, for fifteen months; after which, in April, they should be sown in a light soil, free from stones, and well broken and manured. The drills should be 4 inches apart, and the seed being dribbled in, covered with about half an inch of light earth. It should be protected from the sun by some light branches of the spruce fir, and carefully cleared of weeds, during the two years the plants remain in the seed-bed. The subsequent treatment we have already described. The best months for transplanting the holly are May, August, and September, and this applies as well to other evergreen shrubs as to the holly. This plant loves a moist soil, but will thrive in almost any kind of earth if its early stages of growth are attended to.

17th. The blackthorn (*Prunus spinosa*) is less used than formerly in farm hedges; nevertheless, it forms a close and durable fence, although less woody than the whitethorn. Its roots and off-sets also burrow under the headlands, and cause a considerable deal of trouble to eradicate and keep them under. If, however, cultivated plants are used, there is less of this tendency to throw out suckers than if those taken from woods and coppices are used, which are generally suckers themselves. The blackthorn is useful in filling up gaps and breaches in the whitethorn fences, as it readily takes root in the old bank, and will soon repair the fence.

The sloes of the blackthorn should be gathered in October, and laid in a heap till the spring, when the outside will have decayed, and the stones may be sown in March or April. When the young plants appear, they must be kept free from weeds, and the first spring after, planted out. They will be ready for laying in the fence the second year, as they strike a much longer root downward than the whitethorn, and would be liable to injury if left in the nursery longer. When removed they should be drawn out tenderly, in order not, in the first instance, to break the ground, or, in the second, the tap root. Many of the seeds which did not vegetate with the first growth, come up after it is removed, and produce a second crop.

18th. The beech (*Fagus sylvatica*) forms an excellent fence, and is too little thought of by the husbandman. Although not an evergreen, it retains its dry leaves until late in the spring, and therefore affords excellent shelter for cattle. It may be trained as high as 12 or 15 feet, and by keeping the sides clipped, can be kept at 3 feet of breadth throughout. The beech-mast should be collected when they fall from the trees, which is a proof of their being ripe. As they will vegetate the first spring, they should be kept in a chamber until February, when, a bed having been prepared, they should be sown in drills, and covered an inch thick with mould. When they appear above-ground they must be kept free from weeds. The following November they may be transplanted into the nursery bed in rows 16 inches apart, and the plants 4 inches asunder in the rows. The tops should be cut off, in order to make them throw out lateral shoots at bottom. They may remain in the nursery bed two years, after which, if required, they are ready for the permanent fence, being about 2 feet in height if they have thriven as they ought. If they are not wanted, they will be the better for remaining a year or two longer to acquire more strength.

When wanted for a fence the ground should be marked out, and dug 2 to 3 feet in width, and if trenched the same depth, the better. The plants should be carefully set in 1 foot asunder, either upright, or crossing each other at an angle of 45°, so as to form squares with their stems. The upright position, however, is the most natural, and will probably fill up the fence faster than on the other plan. They should be trimmed the first year with the knife, as they will make but little wood. After that, the shears will come into use, as it will be requisite to make them assume the proper shape. If a fence of limited width is required, the branches must be cut back to 6 or 8 inches of the stems in front, leaving the side branches to fill up the spaces between the stems. July is the best month for this work, as they will then have time to send out shoots and buds before the season is over. The beech hedge grows fast, and, if attended to, in a few years makes a thick close fence against all animals, requiring neither bank nor ditch for its security. It is at present, however, confined in its use chiefly to the garden and pleasure-ground; but it might safely be extended to the field, and would prove more useful and economical than the hedge-and-ditch fence, taking up less than half the room, and affording better shelter to the animals of the farm.

In fact, since the practice of land drainage has come so much under discussion, it has become a serious question whether the ditches might not, in all cases where the land is drained, be wholly dispensed with. It is certain that in most instances they afford no outlet for the water; and even when they do so, their influence extends but a short way into the field, their depth not giving them a very great range of operation. Even in land that is drained, and where the ends of the drains lead the water into the ditch at the outfall, a 2-inch pipe will answer the purpose equally well, laid at the bottom, and the ditch filled up. Generally speaking, whether in drained or undrained land, the ditch of a live hedge is only of use to protect the fence from the cattle; and this may be effected with a post-and-rail fence, the live hedge being planted on the flat. A great deal, however, has to be done before such a change in the mode of fencing on the farm can be adopted; and we can only remark, that where it has been so, it has been found more economical and profitable than the contrary practice.

The hornbeam (*Carpinus betulus*) is a tree sometimes used for a hedge, but much less so than formerly. It is a slow-growing plant, and requires a loam or clay soil to make any progress at all. It is hardy, and bears pruning well, but it does not afford either shelter for, or protection against, cattle, as the beech does. The hornbeam is more used in Germany than in England, and where they are accustomed to its culture, they procure excellent fences of it. The seeds, which ripen in October, may be sown the same autumn; or, if kept till the spring, it should be in sand; after which they may be treated as the beech seeds and plants. The seeds, however, do not require to be covered with mould more than half an inch. Like the beech, it preserves its dead leaves throughout the winter, not shedding them till the new foliage makes its appearance. It was much in use in ancient times for espalier hedges, as it will bear to be clipped into any form. It is easily propagated by layers, and this is the best mode when it is intended for fences; but for timber it should always be raised from seed. The wood is much valued in France and Germany, being hard and tough. It is used for making wheel-naves, screw-presses, heads of beetles, handles of carpenters' tools, &c.; but is too brittle, and too apt to warp, for cabinet-work. It is a native of Europe, and some species of it reach 70 feet in height. As a fence it is rarely to be met with in England; nor is it much planted as a timber tree. In forming fences with it on the Continent, they throw up a parapet of earth with a ditch on each side; the hornbeam sets are then planted in the centre of the parapet, sloping in such a manner that every two sets cross each other at an angle of 45°, in the form of St. Andrew's cross. They then scrape off the bark of each set at the point of contact, by which means the two sets grow to each other, and form a firm and impenetrable barrier. The hedge is kept pruned, and acquires a dense mass of foliage.

In forming a live hedge of any kind, it is proper to plant the sets *in the surface soil,* and not in that which is thrown out of the ditch after the surface has been taken off. This is naturally the richest, having from time to time been manured and cultivated; whereas the subsoil is raw, and not in a fit state to receive them, unless it has previously been trenched and manured, which we would recommend in all cases, as it will always pay for the trouble and expense. In a poor soil, without manure, the growth of a hedge will be very slow; nor will it bear to be trimmed with shears without injury. It is frequently the practice to cut down a young fence after the second or third year, in order to thicken it; and if the soil is rich, the plan is a good one. But in a poor soil the sets will throw out more branches than they can well support, and are weakened rather than strengthened by it.

It was formerly—and we believe the practice is still continued—a common mode to leave a *scarsement* on the face of the bank in forming the fence. This consisted in setting the base of the bank 10 inches back from the edge of the ditch, and laying the sod with the grassy side under to receive the young sets. We cannot conceive any benefit can arise from this practice, whilst many inconveniences are caused by it. It affords a good footing for sheep and hares, by which the young plants of the hedge are endangered, unless dead thorns are laid along the projection to keep off the depredators. There is no doubt the *scarsement* allows a greater body of surface earth for the roots to penetrate into; but it is at the expense of the additional land that is thus occupied.

Perhaps the best plan of forming a live hedge on a farm or an estate that has been previously drained, is to plant the whitethorn upon the flat without any ditch or bank. In that case plants may be procured 4 or 5 feet high; and the ground having been trenched and manured, they may be planted in rows upright at from 8 inches to a foot distance from each other. A moveable hurdle fence will be sufficient protection against cattle on the farm; and in a few years, if proper attention be paid to it, the hedge will want no protection or auxiliary. The *ring-fence,* however, of a farm should be made with hedge and ditch on many accounts—both for the sake of greater distinction in the boundaries, and for the advantage of an outlet for drainage water, which in some cases will require it. It is probable that the introduction of steam culture on the farm, when carried out, as it must eventually be, on the same scale as on the road and in the manufactory, to the exclusion of animal power, will render necessary an entire new arrangement of the fields and of the fences required to enclose them. Large fields, and fences at right angles with each other, without ditch or bank, will then be the rule. The quick will be planted—as the fields will be ploughed—on the flat, so that every inch of land will be available for production; furrows being unnecessary when the land has been efficiently underdrained, which will become universal when the landlords have learned the increased value it will put upon their estates. Where stone is plentiful, it will doubtless be used instead of the live hedge, and will, perhaps, be the cheapest, especially upon the poor mountainous lands of the north of England and Scotland, where they already form the principal boundaries of the fields.

SECTION V.

MANURES.

If we were to go into the history of manures, it would carry us back to primeval times, when the bare rock was first covered with lichens. These, during their life, harboured various tribes of insects; and the decay of both formed an earth, which, in time, accumulating by fresh existences and decays, became a body of black or brown soil capable of sustaining a higher class of vegetation. Not, however, to go further into the formation of soils, which is a very wide subject, we may state, that in the earlier period of the history of agriculture, when the land of an estate was divided into *infield* and *outfield*, the former being the only enclosed part, was also the only part on which cattle could be fattened; consequently, on that account, as well as because it was nearer the homestead, the chief part of the manure raised on the farm was applied to it. The outfield land, which was unenclosed, and liable to the intrusion of all the cattle of the parish when not under crop, was renovated by the triennial fallow, which was considered sufficient to restore its fertility after taking two crops of corn. This system was pursued up to a late period in the seventeenth, and even into the middle of the eighteenth century, on many estates; the covenants in the leases of which with the tenants compelled them to give the land a fallow every third year.

Many years previous to this, however, the eyes of the more enlightened agriculturists were opened to the value of other substances as manures besides farm-yard dung. Fitzherbert, Blith, and others of the early writers, give lists of various matters which they recommend to be used as manure in the absence of a sufficient quantity raised upon the farm. At that period green and root crops, in lieu of fallow, had not been generally adopted. Blith, especially, gives a long list of articles, which has already been referred to (see p. 102), and proves that the right ideas of the means of fertility were beginning to prevail. It required, however, nearly two more centuries to render these ideas generally practical. It was about the close of the last century, when the fallow had given place to the root-crop, that artificial manures began to be used in their production. Bones, first broken with a hammer, woollen rags, rape-seed cake, and a variety of other substances in their natural state, were applied with excellent effect; but an entire ignorance of the chemical properties of these manures, and of the plants they were intended to promote the growth of, led to a great waste. Thus, bones were applied at the rate of a ton and a half per acre—enough, if judiciously managed, for forty-two good crops of wheat.* But bones, in their crude or natural state, decay slowly, and continue to give out phosphates for years after having been applied as manure. The mode, however, of reducing the bones to a state for using as manure was at that period very imperfect, and not calculated to render them immediately assimilable by the plant. The bone-mill has, to a certain extent, facilitated this by reducing them to dust, in which state they decay much faster, and consequently a much smaller quantity is required. But the most effectual plan is a still more recent discovery, by which the bones are dissolved in sulphuric acid into a semi-gelatinous substance, which, decaying or fermenting as soon as it is put into the earth, becomes at once assimilable, as is proved by the effect of a small quantity of superphosphate applied to any kind of vegetable.

The discovery of the use of superphosphate as a manure is certainly due to Sir James Murray, who, so long ago as 1809, and subsequently, used it on his own lands, at Pointfield, near Belfast. In the year 1812 he presented to the Belfast House of Industry a waggon-load of "monster murphies," grown on a field which the members of a Belfast Board frequently had visited "to see potatoes growing over vitriolised bones." In 1832 Dr. Murray lectured on the subject at the Royal Exchange, Dublin, and, in 1842, again at Belfast; and a committee of noblemen and gentlemen was organised to forward the invention; and the journals of that period, by giving the details of the discovery, fix it clearly enough on that eminent chemist. We have thought it nothing more than strict justice to notice this circumstance here, several other persons having arrogated to themselves all the merit of the affair; whilst, instead of being the original discoverers, they are merely copyists, and that after the plan had been publicly promulgated by Sir James, both by his own practice and his lectures.†

By using the superphosphate instead of the crude bones, even reduced to powder, the quantity required for a crop of wheat may be limited almost to what is stated above, or about three-fourths of a hundredweight; because by its reduction it becomes immediately assimilable; and if mixed with earth, and sown or drilled with the wheat, the whole will be taken up by the crop. There is every reason to believe that the sulphuric acid itself acts powerfully in stimulating the plants, as well *per se*, as by presenting the bones in the form most grateful to them. It is a proof how slow, even

* One pound of bones contains phosphate enough for 28 lbs. of wheat. A crop of wheat of 5 qrs. per acre, at 60 lbs. per bushel, weighs 2,400 lbs. Divide this by 28, and it gives rather less than 86 lbs. of bones to a crop. Consequently, a ton and a half, or 3,360 lbs. of bones, is sufficient, if properly applied, for the above number of crops of wheat.

† See the *Edinburgh Journal of Agriculture* for 1858, p. 235. It does not appear at all clear to us how it was that this important discovery, rendered so practical by Sir James Murray's experiments on a large scale, and so publicly acknowledged at the time, could have been so far lost sight of as to leave room for Liebig to say that "it is *possible* that bones dissolved in sulphuric acid would become more readily assimilable to plants;" and from thence to assume the entire merit of the discovery. Yet such, we believe, is the case.

in the present enlightened age, is the progress of useful discovery—that it required thirty years to induce the agriculturists to adopt the use of superphosphate as manure.

A question, however, arises which we have never heard solved, or even publicly stated—whether, in the process of dissolving by the acid, the bones do not lose a portion of their most valuable properties, or have them so neutralised as to be weakened in their influence upon vegetation. It is certain that a material chemical change is effected upon them, and that the soluble salts and volatile gases are liberated; and the question is, whether it is possible to prevent these, or a considerable portion of them, from escaping during the process? We shall have occasion to refer to this subject again in describing the mode of producing the superphosphate.

The employment of oil-cake from rape seed as a manure came into use about the same time as ground bones, and was found to be a valuable acquisition. The quantity used was 1 ton to 3 acres for wheat, sowed broadcast, broken into pieces of about an ounce and a half. A much smaller quantity is now used by reducing it to powder, and drilling it with the wheat or turnips, by which means it becomes at once available to the plant, which receives the whole nourishment it is capable of imparting. Woollen rags had long been employed as manure in the hop grounds, for which plant they were peculiarly adapted. Various other substances also came into use—such as horn shavings, soap lees, the refuse of the slaughter-houses, &c., &c., it being found that any organised matter in a state of decomposition was available for manure. But the crowning acquisition to agriculture, and that which gave the grand stimulus to the use of artificial manures, was the arrival of the first cargo of Peruvian guano, which has effected an important revolution in the ideas of the farmers on the subject of fertilisation, and has been the means or the cause of the introduction of a multitude of compound manures adapted to every description of crop.

The use of guano as a fertiliser has been known in Europe from the period of the discovery of Peru by the Spaniards. It is mentioned expressly by Acosta in his "Naturall and Morall Historie of the Indies;" and he states that the natives of Peru fetched it from an island off the coast, and applied it in the cultivation of their fields. When the Spaniards conquered the country, they, of course, adopted its use; and so jealous were they of allowing it to be exported, that it was constituted a crime to do so. This law continued in force until about the year 1840, when, for the purpose of paying off a heavy debt due to England, the Peruvian government contracted with English merchants for the sale of the guano; and it has proved so abundant a source of wealth to Peru, that the sale has continued to the present time; nor is it at all likely that the privilege will be withdrawn while the islands continue to afford a supply.

SECTION VI.

MANURES—THEIR DISTINCTIVE CHARACTERS.

Manures are divided by agriculturists into two classes, termed Natural and Artificial. Natural manures are strictly limited to those raised from the produce of the farm, as from the straw used for litter, the hay for fodder, the green and root crops, with a portion of the grain for fattening cattle. It is evident, however, that these, under the usual system of farming, will not be sufficient to sustain the fertility of the land, because *all* the cattle fed, and most of the corn raised upon it, are sold, and with them, those elements of fertility required to bring them into a proper state for sale. Consequently, unless some extraordinary equivalent is found, to make up the deficiency, the soil in time will become exhausted of its most valuable properties, and rendered unproductive. Every intelligent farmer knows the effect of such a process; and, therefore, before root crops were introduced, which increase the quantity of manure, without materially exhausting the land, the triennial fallow was had recourse to, as the chief means of renovating the soil.

Besides, however, the mere vegetable manures raised upon the farm, other fertilising or ameliorating substances, the crude products of the earth, were used, which although not generally called natural manures, may with propriety be included in that class. These are lime, chalk, gypsum, marl, coprolites, sea-sand, sea-weed, &c., all of which, with the exception of the first, require no artificial means to render them available for the purpose. Some of these are considered to act chiefly as stimulants or alteratives, possessing no actual *pabulum* or food in themselves alone, capable of sustaining the plants, but increasing and exciting their power of assimilation, and supplying a want in the soil that rendered it partly or wholly unproductive. Thus, in the fine deep alluvial soil of the Flegg hundred in Norfolk, the surface contains no calcareous matter, but the subsoil consists of a fine friable brown marl, effervescing powerfully with an acid, which being brought to the surface, and distributed at the rate of from twenty to forty loads per acre, increases the fertility to such an extent as to carry a course of cropping consisting of wheat, barley, clover, wheat, oats, wheat, and so on, without any appearance of exhaustion. Norwich marl, too, which is raised at the foot of Monshold Hill, possesses such valuable qualities that it is fetched forty miles by water, with a land-carriage of ten or twelve miles, for the purpose of mixing with the soils of the Flegg and Blowfield hundreds, rich as they are in other fertilising properties. The Norwich marl contains, on analysis, 80 per cent. of carbonate of lime and magnesia,* which accounts for its beneficial influence when applied on the land. When it is considered that, according to Boussingault, wheat contains 70 per cent. of carbonaceous secretions, barley and oats 69 each, and peas and beans respectively 32 and 52 per cent., it will be seen how important it must be to maintain the calcareous element in a soil. The large proportion, too, taken by every crop of cereal produce, explains the way in which exhaustion follows the repetition of a wheat crop without compensating the soil for the loss it thereby sustains.

It is believed that a deficiency of the calcareous element in a soil is one cause of the

* The sample was analysed by Professor Davy, of the Royal Dublin Society, in 1852, at the request of the writer.

prevalence of smut, according to an experiment made by a farmer some years ago. He had sown two fields with wheat under precisely similar conditions, in regard to tillage, seed, and manure. The one produced a perfectly clean sample, the other a very smutty one. On procuring an analysis of the soil of each field, he found that the first contained a large portion of phosphate of lime, in which the latter was deficient. He therefore inferred that this deficiency was the sole cause of the smut. "For when the grain has arrived at the stage of its growth at which it would require the starch and animal gluten to be added, in order to perfect its formation, if it should not find the proper materials in the soil for producing them, or the roots of the plants are defective in those parts which would select those materials and convey them to the plant, a decline in the crop will instantly ensue."

There is every reason to think that marl, lime, and other calcareous matters perform various offices when applied to the soil; that they act as *alteratives, stimulants, attrahents*, and as *nutriment;* that they correct the acidities and stimulate the energies of the soil, attract powerfully the elements of fertility from the atmosphere, and prepare them for assimilation by the plants, presenting them at the same time in the form most agreeable. They absorb and retain moisture from the atmosphere in the soil, thus forming a reservoir for the plants in dry weather, which prevents them from suffering the effects of drought. This is the reason why quick-lime has been found so efficacious on the hot burning grounds of Norfolk, and is considered a specific for the cure of "scalds."* It is therefore reckoned amongst the *cold manures;* at least, it is so in Norfolk, where its adaptation to the dry soils of the country justifies the assumption.

Lime promotes the putrefaction or decomposition of animal and vegetable substances, and renders them soluble in water by forming a *hepar-carbonis*, in which state it is rendered capable of absorption by the lacteal vessels of plants. To prove this power in lime, take a quantity of tanner's oak-bark, after its soluble parts have been extracted, and mix it with lime. In two or three months it will be reduced to a fine black earth, which effect, without the lime, would require as many years to be produced by its own spontaneous fermentation. On wet, cold, and undrained land, lime may prove injurious, by being converted into mortar and becoming hard, by which its effect will be neutralised. On dry land it becomes pulverised to a fine powder, and mingles with the soil, where it produces its full effect upon vegetation.

Upon drained clay land the effect of lime is very beneficial in destroying the acidity that may exist, and by its union converting it into gypsum. It thus renders the clay less adhesive and more penetrable by the roots of vegetables.

Although lime has been applied to the land in this country for a great number of years, and its effects have justified the practice, the exact way in which it acts upon the soil and upon the plants is but imperfectly understood. Chemistry has thrown much light on the subject, however, and observation on the different results of its application has also done much to explain the nature of its operation as a *mechanical* agent, in which capacity it is best understood by the practical farmers, the majority of whom are not accustomed to look beyond the more palpable effects. Thus, a clay soil is modified and rendered friable by lime, if it has been laid dry previously by draining. On the other hand, a gravel is made more firm and compact by it, and the same effect is

* Patches of land in a field which, by reason of an open and sterile subsoil, are scorched up in dry weather, while the rest of the field is not affected by it. Such patches usually overlie a deep open subsoil.

produced upon a peaty soil; whilst on a free mixed soil, which derives the greatest benefit from lime, the effects are produced by causes less palpable, but which are most probably referable to all those properties we have mentioned above, both chemical and mechanical. The results, however, let the soil be what it may, are larger crops, whether of grain, roots, or grass, and an improved quality of produce of all kinds.

Lime should be reduced to powder by slaking before it is spread. When brought from the kiln it is in lumps, termed *shells*. These being laid in heaps on the field a few days before applying it, water must be poured over the heaps. This will be absorbed by the lime without causing it to exhibit moisture, being chemically united with it. The heat evolved during the operation is sufficient to reduce iron to a red heat, although it will not burn wood.* When the operation is complete, the heap of shells will have fallen to powder, and the bulk increased to more than double. The slaked lime is then in its most caustic state, and is ready to be applied to the land.

The quantity of lime used varies according to the nature and condition of the land. On the light lands of Norfolk the usual dressing is 3 chaldrons, or about 108 bushels per acre; whilst on newly broken-up land, in which there is much vegetable matter to be decomposed, from 200 to 300 bushels is not thought too much. Without it, the tussocks of turf would be long before they were reduced, and would always be a hindrance to the plough whilst they continued intact. Recourse is therefore had to paring and burning, as the most direct and expeditious mode of getting rid of them, which certainly is effectual enough; but lime would effect the same object, and preserve to the land all the valuable nitrogen or ammonia contained in the plants; and the loss of these will occur, even if the turf is carbonised by covering the heaps with a coating of earth, which is certainly an improvement upon the open method of burning. Stephens considers from 150 to 240 bushels to be average quantities of lime, from the lightest to the heaviest soils, the latter requiring the most.

In breaking up heath or forest land, in which there is generally a large amount of very rough sod mixed with the tough roots of heather, furze, and other shrubby plants, there is no resource but in the first instance to pare, burn, and spread the ashes of the entire surface. Afterwards, to dissolve the remaining vegetable substances, a moderate dressing of lime should be applied, which will complete the reduction of the soil to a state ready for the intended crop, whether of oats, wheat, or turnips.

It has been the custom to apply lime periodically to cultivated land, the propriety of which depends upon the nature of the soil. If this is already of a calcareous composition, lime is not required; and there is no doubt that the covenants in some of the old leases, which compelled the tenants to apply lime at certain intervals to all their lands, were productive, if not of positive mischief, at least of so much loss to the tenant as the cost of the lime involved. To apply lime to a soil already full of calcareous matters, is, indeed, "carrying coals to Newcastle," and can only be excused by the ignorance that prevailed respecting the composition of soils. There are, however, soils so destitute of lime in any form, that, unless they periodically receive a dressing of lime or marl, they will produce no crops. We have already referred to the case of some of the otherwise richest lands in Ireland—those of Tipperary and Westmeath, which, though lying on the

* The writer was once present at a fire, by which a whole farmstead was destroyed, and which was occasioned by some quick-lime being placed against the woodwork of a barn. Rain fell, which slaked the lime, *heated the nails in the wood*, and these ignited the wood itself, and the whole premises were quickly in a blaze. We refer to this as a caution.

limestone plain, with an interminable subsoil of that material, have a surface soil so destitute of all calcareous matter, that, unless lime is applied in one form or other, no wheat can be obtained from it. After the famine, in consequence of the discontinuance of its use, the land, which had previously produced 20 barrels of 20 stone each, or 95 bushels, per Irish acre, did not yield more than from 5 to 8 barrels, and in some cases not more than 1, per acre. The means at present of ascertaining the composition of the soil are so easy of access that no one need to be at a loss respecting the propriety or otherwise of applying lime to his land.

On the clay soils of Scotland it is the practice to give a strong dressing of from 8 to 10 tons of caustic lime per acre (taking one-sixth of the land each year) at the commencement of the lease. The whole farm is thus dressed in six years, and requires no more during the term, but continues to increase in fertility to the end, if well managed in other respects.

With regard to the time that a dressing of lime will last in a soil, there is much misapprehension in the minds of many farmers, and no doubt it varies considerably in different kinds of land. But the reason why it requires frequent dressing is because the tendency of lime is to descend in the soil, especially in those of a loose, friable nature; so that unless the subsoil is brought up to the surface every now and then, the lime is lost. Morton is of opinion that there is no reason why a good dose of lime should not last 100 years, if it were not for its tendency to sink deeper and deeper into the soil. He estimates that the crops do not remove more than 1 cwt. per acre per annum, at which rate a dressing of 5 tons would last 100 years. He therefore leaves it a question with the farmer whether it will be most economical to break up the subsoil, and thus render the lime that has disappeared available, or to give the land a new dressing instead. If the recovery of the lime were the only benefit to be derived from subsoiling, we should say that a new application of lime would be the most economical. But there are so many collateral benefits arising from trenching and subsoiling, that they outweigh all considerations of extra expense. If, however, the land is foul with vegetable matter, such as weeds, couch-grass, &c., a fresh dressing of lime is necessary to destroy them; and if it be liable to slugs, worms, and other live nuisances to the farm, fresh caustic lime is the readiest means to get rid of them.

If caustic lime is applied, with farm-yard or other manure for a crop, it should be laid on some time previously, in order that its most pungent properties may become modified, and its substance well incorporated with the soil. By immediate contact, the ammoniacal substances in the dung will be decomposed by the lime, and, being volatilised, will escape, and be lost; for although the soil itself possesses the power of attracting and retaining ammonia in a gaseous form, to a certain extent, it is doubtful whether, in the presence of caustic lime, this property of the soil would be sufficiently powerful to counteract the effects, or to absorb all the ammonia so suddenly and so copiously liberated from the fresh manure. There is, however, much to learn on this subject, every opinion at present entertained being founded rather on conjecture and induction than on experimental facts. We know that lime subjected to the action of the atmosphere soon loses its more caustic properties, and is resolved into the carbonate state, in which it exercises a very modified influence on the ammoniacal gases.

The effect of lime is beneficial on all crops, except that of potatoes; but most so on grass land and clovers. It promotes the growth of white clover, even where it has not been sown, to such an extent as to give rise to the idea amongst ignorant men that it possesses in itself the seeds of that plant. Old mortar spread over land will cause the white clover to spring up abundantly. On grass land it improves the quality, by destroying the sour and coarse grasses, and promoting the growth of the finer and sweeter species.

The value of marl is not much, if at all, below that of lime as a restorative of the soil, and it possesses also additional properties which render it still more so. By its saponaceous, and, at the same time, friable nature, it alters the texture of every soil to which it is applied, giving to light land greater solidity, and to the weak greater strength. Whilst it produces these effects upon the sands and gravels, it is equally beneficial on a clay soil in loosening its texture and causing it to work more freely. Marl of good quality is more durable than lime;* for, being specifically lighter, it is retained longer in the soil. Lord Kames mentions an instance which came under his own knowledge, in which two ridges of land in a field which had been marled 120 years before, still maintained their superiority in the production of grass over the rest of the field. Anderson also speaks of a field on which a thick coating of shell marl was laid, which bore excellent crops for thirty years without any additional improvement.

The value of marl depends much on its composition, some kinds containing a greater proportion of carbonaceous matters than others. To test its value, the following simple process has been recommended:—Put a few ounces of pure spirit of nitre into a Florence flask: place this in a scale, and balance it with shot or any other small substance. Reduce a few ounces of dry marl into powder, and pour it carefully and gradually into the flask, agitating it repeatedly till no effervescence can be perceived. The remainder of the marl must be then dried and weighed, and the difference in weight between it and what was first put into the flask determines the amount of the escape of gas during the operation. If the loss averages from 13 to 32 per cent., it proves it to be genuine calcareous marl. The argillaceous marl is much less valuable, and contains from 68 to 80 per cent. of clay, although it holds enough of calcareous matter to effervesce with an acid; but it is more unctuous when moist, is of a brown or grey colour, breaks more slowly in water, and generally in squares. When tried in a flask by the above process, its loss is not more than from 8 to 10 per cent. It is probable that the brown marl of the Flegg hundred, in Norfolk, mentioned above, is of this description.

Siliceous or sandy marl is composed of small quantities of clay and calcareous matters, and from 75 to 80 per cent. of sand. Its colour is brownish or reddish grey, it is friable and flakey, but sometimes is found in very hard lumps. It decomposes slowly in the air, effervesces slightly with an acid, and the residue is not adhesive.

The quantity of marl to be applied varies considerably with the nature of the land, its condition, and the quality of the marl. From 50 to 150 one-horse cart-loads are laid on to light lands, but from 30 to 50 are sufficient for the clay soils. The clay-marl is of little use on the latter, but both the shell and the siliceous marls will much improve them. It is best to lay marl upon a clover stubble, when it should remain on the surface all winter to receive the benefit of the frost, snow, and rain; under which it will crumble to

* It is an ancient saying that "a man doth *sand* for himselfe; *lyme* for his sonne; and *marl* for his grandsonne." "Every one for himself, and heaven for us all," is the modern maxim.

powder when the harrows are applied. It requires two seasons to bring its beneficial influence into full operation, after which it becomes well incorporated with the soil, improving its texture, making the light sandy or peaty earths more adhesive and retentive of moisture, and correcting the acidities that abound in some soils, especially those that are undrained. The following analyses of two kinds of marl will show the difference in their composition:—

PEAT SHELL MARL.

	From the top of the bed.	From the bottom of the bed.
Carbonate of lime	77·6	81·7
Oxide of iron and alumina	1·8	0·6
Organic matter	14·6	14·6
Insoluble, chiefly siliceous	6·0	3·1
	100·0	100·0

CLAY MARL.

Carbonate of lime	8·4
Oxide of iron and alumina	2·2
Organic matter	2·8
Clay and siliceous matter	84·9
Water	1·4
	99·7

The above figures point out clearly enough in what way, and on what description of land, either of these marls ought to be applied. It is remarkable that at the bottom of most, if not all, the bogs of Ireland, a gravelly kind of marl is found, which is the best manure that can be applied to the undrained bog. We have witnessed the effect upon such land the first year of its being cultivated. The produce was a heavy crop of potato oats of fine quality, weighing at least 42 lbs. per bushel. No other manure was applied; and it is probable that if the marl had not been employed, there would have been little or no crop of grain. The gravel in this marl is limestone, which is the character of all the gravel in Ireland, there being no red siliceous gravel like that of England in any part of the country, except what is imported.

The use of marl is of very ancient date in Britain. In the year 1225 (the 10th Henry III.) an act was passed giving every man leave to sink a marl pit in his own ground without being fined; and in the 12th Edward I., A.D. 1283, the sheriff and coroner are instructed to inquire "*de fossatis et marleris levatis juxta itar publicum*"—proving the common use of the material. Old leases are still extant of the reigns of Edward I. and II., the covenants of which compelled the tenants to marl their lands. In Norfolk it has long been a specific for exhausted or weak soils, as is proved by the state of old marl pits, in many of which large oak trees and ancient brushwood are found; and also by the many hollows, partly filled in and levelled, in the fields, which are no other than exhausted marl pits. The material found in that county is chiefly, if not entirely, shell marl; whereas in Suffolk the clay marl prevails. In the latter county it is applied with excellent effect indiscriminately to all kinds of lands, but is peculiarly beneficial to the light sands, which without it would produce little or no grain.

Chalk marl is the lowest stratum of the chalk formation, and is found in many parts of England, but especially under the chalk basin of the vicinity of the metropolis. It has been used extensively for manure, and invariably with excellent effect. The following is its composition, according to the analysis made by the direction of the Royal Agricultural Society of England:—

Insoluble siliceous matter	19·64
Soluble silica	6·45
Phosphoric acid (equal to 3·75 bone-earth)	1·82
Carbonic acid	28·98
Lime	37·71
Magnesia	0·68
Oxide of iron and alumina	3·04
	98·32

Chalk marl is used in Essex, Hampshire, Wiltshire, Yorkshire, and other counties. Its effect is excellent at first, but it loses its virtue in a very few years, which its composition, as given above, will account for. It is used on the light soils to consolidate them, and on the heavy to render them more friable. The quantity applied varies considerably; from 15 cart-loads in Essex, to 80 cubic yards in Lincolnshire, and 2,000 bushels in Hampshire, to the acre. The action of this marl upon clay is in assisting to liberate the water contained in it, which is otherwise locked up, as it were, hermetically. "Clay," says Kirwan, "in its usual state of dryness, can absorb two and a half times its weight of water without suffering any of it to drop out, and retains it in the open air more pertinaciously than any other earth; but in freezing, cold clay contracts more than other earths, squeezing out its water, and thus parting with more of it than other earths." A ball or lump of clay, therefore, under the influence of frost, instead of being split or burst, like marl, exudes the water to its surface, where the frost crystallises it, the clay retaining its form, but the lump diminished in size and weight.

The siliceous and calcareous matters in the marl, when they become incorporated with the clay, correct this property, and assist in the liberation of the water by the disintegration of the clay, instead of by mere extrusion by condensation. The case is not the same with cold wet clay when it is dried. We may therefore account for the cause that a purely clay soil, undrained and unameliorated by a calcareous or siliceous mixture, is the worst land that a farmer can have to contend with. Drowned in winter, and baked in summer, the tender rootlets of plants have no power to penetrate the hard lumps, and become stunted; and yet such lands, when well farmed, prove the most profitable that can be cultivated.

Marls, however, differ so much in their composition, that, in applying them, it is absolutely necessary to learn their chemical compounds in order to know how much to apply. Thus, the range of the proportion of carbonate of lime is from 8 to 85 per cent.; consequently, the quantity that would be fully efficient of the latter would have no effect if applied of the former. Clay marls, also, are richer, in soluble salts of potash than the shell marls, and are therefore peculiarly valuable in soils deficient of that element of fertility. On the other hand, on soils deficient in lime, the chalk or shell marls are best adapted to supply it. All marls act more powerfully when accompanied with farm-yard manure.

Gypsum, or hydrated sulphate of lime, is another mineral manure, of the value of which, in agriculture, the opinions of both scientific and practical men widely differ. Sir Humphrey Davy was, we believe, the first chemist who treated on it in a practical way, and his opinion was, that to a certain class of plants, as clover, trefoil, sainfoin, white clover, and other plants, it was beneficial, which was owing to those plants requiring a considerable proportion of sulphate of lime in their food; and that if it failed in some instances of producing any effect, it was because the soil was previously saturated sufficiently with that material. The following is the composition of gypsum:—

Lime	32 56
Sulphuric acid	46 51
Water	20 93
	100 00

Selenite, a crystallisation, and *alabaster*, are modifications of gypsum.

Liebig thinks that the action of gypsum on the grasses is owing to its power of converting the volatile carbonate of ammonia into the fixed sulphate of ammonia. If sulphate of lime is mixed with a solution of carbonate of ammonia, the smell immediately disappears. An interchange of elements takes place, by which carbonate of lime and sulphate of ammonia are formed, and the latter salt remains intact in the liquid. The learned Professor therefore ascribes the beneficial action of gypsum upon plants to its power of converting carbonate of ammonia, a volatile salt, into sulphate of ammonia, a fixed salt; and thus, the ammonia contained in rain-water, a portion of which otherwise evaporates and returns to the atmosphere, is fixed by the gypsum and converted into sulphate of ammonia, and becomes in that form the food of plants, in which capacity he considers that gypsum acts *of itself*, as well as in supplying them with ammonia more abundantly.

On the other hand, M. Boussingault denies that gypsum possesses the power ascribed to it by Liebig, of fixing the carbonate of ammonia, on the principle laid down by Berthollet, that "when solutions of two salts are mixed, containing between them the elements of a third *insoluble salt*, mutual decomposition will take place, and that insoluble salt will be produced. If, therefore, solutions of sulphate of lime and carbonate of ammonia are mixed, a precipitate of carbonate of lime, which is insoluble, is obtained, and sulphate of ammonia remains in the liquid form."*

M. Boussingault agrees with Sir Humphrey Davy in assuming that it is only those plants that require large supplies of sulphate of ammonia are benefited by the application of gypsum. Held in a condition sufficiently soluble to be appropriated by the roots of plants, the sulphate of ammonia is capable of being taken up by those plants, of which it constitutes a principal element, in large quantities of constant strength, being dissolved in the proportion of I to 500 in the water contained in the soil, and is thus qualified to furnish a sufficient supply to the plants under any conditions of the soil, whether in drought or wet.

To prove the effect of gypsum upon clover, M. Boussingault analysed the ashes of the roots of that plant manured with gypsum, and some others not manured with it. The result was, that the quantity of lime absorbed by the first was disproportionably large as compared with the sulphuric acid absorbed at the same time; and he comes to the conclusion that gypsum acts merely as the means of supplying lime to clover, sainfoin, and plants of that kind.

Such are the adverse opinions of the most eminent scientific men; and it is not a little remarkable that experience and common sense, applied to it, have upset all their

* "Economie Rurale" (translation, p. 429).

theories. By analysis, other plants are found to contain a large proportion of lime, which receive no benefit whatever from the application of gypsum. Thus, a ton of carrots contains in its ashes 197 lbs. of lime, whilst a ton of red and white clover contains only 50 lbs. of that material; yet the crops of the latter are doubled, whilst those of the former receive no benefit whatever from the application of gypsum. It is the same with regard to sulphuric acid. The ashes of 24 tons of the bulbs and leaves of turnips contain 50 lbs. of sulphuric acid, and the same quantity of carrots, 57 lbs. The ashes of a ton of white clover hay contained $6\frac{1}{2}$ lbs., and of a ton of red clover $12\frac{1}{2}$ lbs. of sulphuric acid. A fair crop of turnips, therefore, appropriates as much sulphuric acid as 8 tons of white or 4 tons of red clover hay. And yet while, according to the analyses of M. Boussingault, the crop of clover is doubled by the application of 15 bushels of gypsum, that of turnips, as well as other plants, receives no benefit whatever from it. It is, therefore, still an open question in what way gypsum is beneficial to certain plants; whilst others, which contain similar elements, are unaffected by it. The following are the results of experiments made by M. Boussingault:—

Growth of Sainfoin on Soils Gypsised and Ungypsised.

	Dry herb per acre.	Seed per acre.	Weight of total crop.	Proportion of stalk to seed.
	lbs.	lbs.	lbs.	
1. Crop on deep soil, ungypsised	3·357	419	3·776	100 : 12·5
Crop upon the contiguous breadth, which had received about 15 bushels of gypsum in April	4·381	582	6·044	100 : 10·7
Difference in favour of gypsised breadth . . .	2·105	163	2·268	
2. Crop upon the same soil, of less depth, and not gypsised .	2·766	245	3·011	100 : 8·9
Crop on contiguous soil, dressed with about 15 bushels of gypsum	4·381	379	4·760	100 : 8·7
Difference in favour of gypsum	1·615	134	1·749	
3. Crop on the same soil, 3 inches deep, and not gypsised . .	2·068	66	2·134	100 : 3·2
Crop on contiguous soil, dressed with about 15 bushels of gypsum	4·381	211	5·090	100 : 4·3
Difference in favour of gypsum	2·811	145	2·956	

Produce of Wheat with and without Dressing with Gypsum.

	Gypsised.	Not gypsised.	Not gypsised.
1842.	lbs.	lbs.	lbs.
Wheat after clover	319	323	317
Wheat after mangold-wurzel . . .	195	176	158
Wheat after potatoes	235	158	264
Average of three experiments .	250	248	250
	Sheaves.	Grain.	Straw, chaff, and waste.
1843.	lbs.	lbs.	lbs.
Rye with gypsum	516	137	279
Rye without gypsum	472	127	345
Wheat with gypsum	462	147	315
Wheat without gypsum	510	156	254
Wheat without gypsum	453	143	310
Oats with gypsum	329	112	217
Oats without gypsum	368	113	255

In applying gypsum, it should be ground as fine as meal, and used as a top-dressing in April or May, in quantities of from 6 to 15 bushels per acre. After the first shower, its beneficial effects are seen upon the clovers, trefoils, and rye grass, in their healthy and vigorous growth. It is more used on the Continent and in North America than in England, and in both the former it has been in use upwards of a century. In Germany, one Schubert was knighted by Joseph I., under the title of "*Schubert von Kleefeld*," or Schubert of the Clover-field, on account of the efforts he made to extend the use of gypsum for the cultivation of clover. In the "Year-book of American Agriculture for 1855-6" is a clever paper on the use of gypsum, in which the writer states, that while some farmers have found it beneficial in all crops, others have found it universally fail. This latter consequence he ascribes to ignorance of the circumstances of the soil, season, and other things; but he admits that those cases in which it has proved useful to cereal crops are exceptional, and that the clovers and leguminous plants receive most benefit from it; and he sums up his arguments in the following manner:—

"Admitting that much remains to be learned, still it is evident that, for practical purposes, thus much may be accepted, viz.:—

"1. Leguminous plants are especially benefited by plaster; while

"2. All other plants of large foliage, whose agricultural value *does not consist in the production of seeds*, are usually aided by it in growth, upon

"3. Soils not already containing sulphate of lime; but

"4. In which all other parts of mineral plant-food are present in available form, and in sufficient quantity; which are, in practical language, *well danged*, if not rich without manure, and which, further,

"5. Present no physical obstacles to vegetable growth; which are dry, sufficiently porous, and well tilled; when

"6. The climate and weather are favourable to vegetation, when the temperature is mild, and rains are frequent, but moderate."

While, therefore, the most certain benefit derived from the application of gypsum is limited to clover and other broad-leafed plants, and its use to cereals is at least exceptional, if not in all cases doubtful, the contrariety of opinion on the subject amongst both scientific and practical men proves that nothing definite is known of the precise mode of its action upon the soil or upon plants, or what is required to render it as beneficial to cereals as to clover, when both abstract from the soil the same elements contained in it which were supposed to be the cause of its value to the broad-leafed plants. Speaking on this subject, Mr. Morton says:—"Whilst, however, the current theories wholly fail to satisfy us, we are unprepared to offer any other in their place. In seeking to apply the ordinary laws of chemical action to the phenomena of animal, and still more, of vegetable life, we must expect to find ourselves sometimes entirely at fault; and, indeed, leaving out of the question these more difficult problems, the chemistry of soils has as yet scarcely been investigated, and we have only just now learned that chemical changes, which, in their abstract form are looked upon as axioms of the science, are suspended or altogether reversed when the soil is the sphere of their operations. It is better to confess our ignorance, and to wait patiently for the light of truth, than to hazard conjectures which will not bear a close scrutiny, and serve only to retard the progress of knowledge."*

* Morton's "Cyclopædia of Agriculture."

Sand, as a manure for dressing stiff clay soils, was extensively employed towards the close of the last century, and with very beneficial effect, both as an alterative and as increasing the bed of vegetable earth. In its pure state it contains none of the elements of fertility, so that its action is purely mechanical. There are, however, different kinds of sand, some of which are very valuable as fertilisers as well as alteratives. Such is the sea or shell sand found on many parts of our coasts, particularly in Ireland, of which we shall presently have to speak.

The best common sand for mixing in a clay soil is that washed down by the rain from roads or hills, or that taken out of the beds of rivers. It should be mixed with dung by laying it at the bottom of dung-heaps, and also covering them over with it. If applied alone as a dressing, the quantity must be proportioned to the stiffness of the soil. Some writers have recommended to lay on a very strong soil a coat of sand equal to two of farm-yard manure, or even more. In Cheshire, where it was extensively employed, as much as 300 loads per statute acre were laid upon bog land that had been reclaimed, with excellent effect. With a mixture of well-rotted dung it makes an excellent compost for pasture lands. The red sand is considered the best, on account of the oxide of iron it contains, which gives it a more soft and unctuous feeling. Sand restores strong clay lands to a friable pulverulent state, when it becomes thoroughly incorporated, and thereby greatly increases its fertility. If the land is in tillage, the yield of grain will be increased; and if under grass, both the quantity and the quality will be improved, and the land will be less liable to be parched in dry summer weather. On wet, coarse, rushy lands, sand is found very beneficial in destroying the coarse herbage, and brings the sward into a fine state. In such cases, a very thick coat should be applied to be effective. On strong-land farms sand should be freely used, if accessible, for laying at the bottoms of dunghills, and also for littering the stables and bullock-sheds. In these latter cases, it should be laid thick, to receive the excreta of the animals, removing it frequently, with the other litter. Under the dung-heap, it should be at least a foot in thickness, and as much more laid on the top when the heap is made up. When the heap is turned, the sand will become incorporated with the dung, and form a most valuable compost for either grass or arable land.

Shell, or sea sand, is of a more valuable kind, in proportion to the amount of organic matters it contains. It is found in deep beds, frequently on spots that are only dry enough to procure it at low water. It consists, more or less, of sand mixed with minute portions of sea-shells and coral, broken up by the friction of the tides, and gradually deposited in these deep beds. It is found about Plymouth, and on the southern coast, of a bluish-grey colour, supposed to be owing to the large proportion of mussel shells, and of other dark-coloured shells, broken and mixed with the sand. Near the Land's End it is white, whilst on the north coast it is yellowish, brown, or reddish, containing a very large proportion of cockle-shells. The reddish sand is considered the best. In all those parts where this sand is found, it is used, generally with the best effect, both on grass and arable land. In Scotland, on the coast of Aberdeen, Fife, Banff, Sutherland, Caithness, and Dumfries, large beds of shell-sand exist, and are much used by the farmers as manure. It is still more abundant on the west coast of Scotland and amongst the islands, and is applied to the land in large quantities with wonderful effect, especially upon the mossy soils. It is particularly beneficial on clay soils, which become ameliorated and more friable by a mixture with it.

In Ireland, it has for many years been a favourite dressing, especially for inferior land, such as cold clay and peaty soils. It is estimated by Sir R. Kane that 300,000 tons are taken from the harbour and strand of Youghall, and upwards of 1,000,000 tons from Cork, Kinsale, and Ringabella. In Oyster Haven, a small creek of Cork Harbour, there are thirty-two boats, of 12 tons each, employed in dredging sand, some of which make about 150 boat-loads each in the year. This sand is sold on the spot, at from 6*s*. 6*d*. to 7*s*. 6*d*. the boat-load. It is dredged at the depth of from 10 to 30 feet, and about twenty dredgings complete the boat-load. It is laid on the beach, and fetched away in carts and boats, and taken up the country, where it is sold to the farmers. Some of this sand has been found, on analysis, to contain as much as 65 per cent. of carbonate of lime. At Loch Foyle, on the north coast of Ireland, when the tide is out, there are extensive flats of sea-sand, which have been worked by the people in the neighbourhood for upwards of a century, without any fear of the supply being exhausted. These flats consist to a much greater extent of shells than that of the south coast. Two hundred and eighty-five men and fifty boys are employed six months of the year in raising the shells, at a cost of 10*s*. and 6*s*. each respectively per week. The total quantity raised is about 60,000 tons each summer, and it is sold on the shore opposite to the bank, at 1*s*. per ton, and at Derry and Strabane, at 1*s*. 6*d*. to 2*s*. per ton. Captain Portlock estimates the shell-banks of Loch Foyle to be worth £5,000 per annum to the country, and that the material is "particularly useful for bringing bad lands into cultivation, and improving stiff wet clay, deficient in calcareous matter; being applied at the rate of from 30 to 40 barrels per acre. It is preferred to lime, as warming and brittling the land."*

The composition of these different kinds of shell-sand are said to be as follows:—Siliceous sand, from 30 to 60 per cent.; the shells, from 20 to 50, which, besides carbonate, yield some phosphate of lime and magnesia; from 3 to 6 per cent. of animal matter, yielding nitrogen by its decomposition; and from 5 to 10 per cent. of water, holding in solution the usual ingredients of sea-water. It, therefore, is preferable to lime by furnishing so many valuable materials to the soil. Many parts of Ireland are quite destitute of a mixture of calcareous matter in the soil, and to these the shell-sand must be invaluable, by furnishing that material; without which the land would not bear wheat. It is also applied with great success to the potato crop; but sea-weed is still more beneficial to that root, and is laid on the land in large quantities near the coast, but is too heavy for long carriage. The people on the coast, however, send it a considerable distance inland, having previously dried it in the air.

There is no doubt that on many of the estuaries on our coasts, shell-sand may be obtained in considerable quantities, as is the case in Cornwall and other parts we have mentioned. A sample was sent to us a few months since from a northern port, of which the party sending it had formed the most extravagant expectations. Without having actually tried its virtue on the land, he called it guano, and expected to find it a mine of wealth to the farmers in the neighbourhood. It consisted chiefly of argillaceous mud, with a considerable portion of siliceous sand, with (possibly) a portion of shell, but not discernible by the naked eye. The only question with us was whether it would pay for raising, labour being at a higher rate in England than in Ireland, and the material less

* Portlock's "Report on the Survey of Derry and Tyrone."

valuable. At the same time, as an *alterative*, it would probably be of use on land long accustomed only to farm-yard manure.

Coprolites are a marine fossil, and are obtained from the crag formation in great abundance. The following is the composition of coprolites according to the analysis of Professor Way:—

Water (of combination) and a little bituminous matter	10
Sand, clay, and oxide of iron	21
Carbonate of lime	10
Phosphate of lime	56
Fluoride of calcium, with a small portion of alkaline sulphates and chlorides	3
	100

Coprolites are used extensively either as a simple manure, or made into superphosphate of lime. In the latter case they require to be finely pulverised, otherwise the acid will not act upon them. There are various kinds of coprolites, evidently not of the same origin, and they are distinguished by naturalists as coprolites and pseudo-coprolites. The true coprolites contain phosphates of lime, phosphates of magnesia, carbonate of lime, and other substances, and are found in rounded nodules from a few ounces to several pounds in weight. They are believed to be chiefly composed of the excrements of reptiles and other animals, being sometimes found in the vicinity of the bones of whales, saurians, &c., the flesh of which has also become mixed up with them, although they now exhibit no indications of organic origin. Mr. Nesbit has given the following table of the composition of different samples of coprolites according to the deposit in which each was found:—

	Phosphoric acid per cent.
Found in the tertiary deposit-crag	19·19 to 22·17
London clay	15·96 ,, 28·00
Chalk	19·00 ,, 26·90
Green marl	16·47 ,, 26·56
Green sand	7·72 ,, 13·81

At the Aust-passage cliffs on the left bank of the Severn, near Bristol, there has been discovered a "bone-bed consisting of two beds of lias from 1 to 2 feet thick each, densely loaded with dislocated bones, and teeth, and scales, of extinct reptiles and fishes, interspersed with abundance of coprolites derived from animals of various kinds." The following is the analysis of the coprolites by Professor Herepath, of Bristol:—

Water	3·400	
Organic matter	trace	
Silica	13·240	
Carbonate of lime	28·400	
Phosphate of lime, magnesia, iron, &c.	53·730	— phosphoric acid, 26·615
Sulphate of lime	0·736	
Loss	0·494	
	100·000	

Burnt-clay is essentially useful upon stiff soils when sand or marl cannot be obtained. The method generally pursued to procure it is very simple. A fire is first made of wood or coal, and on it are laid a few lumps of clay. These should be dry in the first instance, in order to receive the heat more readily. When they have become well ignited, add more, slowly at first; but as soon as a good body of fire is obtained, the clay may be added in the state in which it is dug. By this means, having two or three heaps on fire at the same time, and adding fresh clay wherever the fire breaks through, it may be laid on as fast as a staff of four or six men can raise it, and a few hundred tons may soon be ready for distribution. Care should be taken to prevent the fire from bursting out, by covering it whenever it appears. By this means the clay is *charred*, and contains whatever valuable elements it possessed before the operation. Clay in this state not only lightens a heavy soil, but it imparts a warmth to it, and thus acts as a stimulant to vegetation, as well as an ameliorator. If small coal is spread over the layers of clay it will both facilitate the calcination, and improve, by the ashes, the quality of the mass. It may be laid on at the rate of 50 tons per acre, being previously broken small—if to powder, the better.

"When clay," says Dr. Darwin, "is united with so much oxygen by fire as to form a soft or imperfect brick, it possesses the power of promoting the generation of the nitrous acid in certain situations, which is frequently seen like an efflorescence on mouldering walls, having become, by the addition of lime, a calcareous nitre. The use of these soft bricks in the production of nitre is well known in Paris, where the rubbish of old houses is regularly purchased for that purpose, which before the Revolution was a royal manufacture.

"As these soft efflorescent bricks from old houses are known powerfully to promote vegetation when pulverised and mixed with the soil, at the same time that they are capable of producing the nitrous acid, I imagine that the use of paring and burning the turf of some newly-enclosed commons depends on this circumstance—that is, that the heat emitted from the burning vegetable fibres unites oxygen with the clay, which latter forms more than half of the slices of turf as they are dug from the ground. In other respects the paring and burning of grass lands would certainly be a wasteful practice, as much carbon is converted into carbonic acid, and dispersed along with the uninflamed smoke or soot, and nothing left but the vegetable ashes. From these considerations, it would probably be worthy of experiment on farms where coal and clay abound to burn the latter to a certain degree, which might supply an exhaustless source of profitable manure."*

The above passage contains the rationale of burning clay for manure. The process has since been extensively adopted, especially in the coal districts, generally with much benefit to the strong clay lands. The expense of burning 100 three-horse cart-loads is estimated at £6 9*s.* 6*d.*

Salt, as a condiment or stimulant, and applied in proper quantities, is a valuable ingredient as a dressing on land. It possesses no nourishment in itself, but has the power of inciting the vegetable absorbents into greater action, and thereby enabling them to take up more nutriment. It must, however, be used with great caution; for if the dose is too large it will destroy all vegetation. Nor should it be repeated too frequently, except in very small proportions, and mixed with manure, with which it will become incorporated through the moisture, and will act less powerfully, and consequently more beneficially. If applied alone, it should be distributed some time before sowing or planting. The action of salt on vegetables is exemplified in the practice of some gardeners, who, "if they require spinach or asparagus to be stimulated in their growth, apply salt to them early; or, if a flower is required, whether of the broccoli, artichoke, or the tulip or hyacinth, moisten them with a slight solution of salt when the flower-bud

* Darwin's "Philosophy of Agriculture," p. 216.

is formed; and when fruit or seed is wanted, as in melons and cucumbers, or peas and beans, apply the solution of salt still later, and at all times with rather a parsimonious hand."*

Common salt, when quite pure, contains 39·66 of sodium, and 60·34 of chlorine. It dissolves in 2·78 times its own weight of water at any temperature from 60° to 212° Fahr. The Cheshire salt mines are the most extensive in England, the deposits varying in thickness from 4 feet to 130 feet, with alternate strata of limestone, clay, sandstone, and gypsum. The blocks of rock salt in these mines are chiefly impregnated with a portion of oxide of iron and other substances, which impart to them a flesh colour, red, greyish, or yellow tint, according to the predominance of either impurity. Blocks of pure salt are sometimes found, and these are perfectly white. The following is the composition of Cheshire salt of three descriptions, as found on analysis:—

	Store Rock Salt.	Fishery Rock Salt.	Common Rock Salt.
Chloride of sodium . .	98·250	98·675	98·350
Chloride of calcium . .	·025	·025	·025
Chloride of magnesia .	·075	·075	·075
Sulphate of lime . . .	1·570	1·125	1·450
Insoluble matter . . .	·100	·100	·100
	100·000	100·000	100·000

There is a great difference of opinion amongst agriculturists respecting the value or utility of salt to the land; but we apprehend that where it has failed to produce a beneficial effect, it was probably owing to a want of judgment or knowledge in the party. In fact, it requires a chemical knowledge of the character of the soil on which it is applied, and of the quantity or proportion to be applied, in order to use it with the best effect. Dr. Belcker instituted a series of experiments with the view of throwing light upon the subject, and the following were the results of his inquiries:—

1. That a solution of from 3 to 24 grains to the imperial pint produced no injurious effects upon cabbages, field beans, onions, lentils, chickweed, groundsel, thistles, annual meadow-grass, or radishes, which were watered with it for two months; but that plants of *Anthox anthum odoratum*, or sweet-scented vernal, were destroyed in one month by a solution of 24 grains to the pint.

2. That these solutions benefited most plants to which they were applied, especially cabbages, radishes, and lentils, all which presented a more florid and luxuriant appearance than when watered with rain-water only; and this healthy or vigorous appearance was in proportion to the quantity of salt or strength of the solution applied, up to 24 grains per pint.

3. That solutions of salt of the strength of 48 grains to the pint of water produced a deleterious effect, in the course of a month, on chickweed, groundsel, annual meadow-grass, and lentils; whilst cabbages, radishes, onions, field-beans, and thistles, were uninjured by it.

4. The proportion of 96 grains of salt to the pint of water proved injurious to cabbages and field-beans, but inflicted no injury on onions, radishes, or thistles watered with it for two months.

5. That cabbages will continue to grow, though sickly, when watered with a salt

* Darwin, p. 337.

solution of 192 grains to the pint for a month, and that even a solution of 384 grains per pint did not destroy them.

6. But the solution of 192 grains destroyed the onions watered with it for one month.

7. That a solution of 24 grains of salt per pint was beneficial to cabbages, onions, radishes, and lentils.

8. That the application of salt has a more immediate effect upon the grasses than on any other plants.

9. That bulbous plants, and those with succulent leaves, derive especial benefit from the moderate application of salt.

It has been ascertained that in most of the cases in which salt has failed to produce a good effect on vegetation the lands operated upon lie near the sea-coast, and are consequently already saturated with salt. It is therefore more likely to be of benefit in inland parts of the country, away from the influence of the sea air, which is always impregnated with saline particles. The utility of salt, in fact, appears not to arise from its possessing the elements of fertility in itself, but from its faculty both of stimulating the plants to receive nourishment, and in preparing it for them.* The quantity of salt applied to land is from 10 to 20 bushels per acre, and the crops found to be most benefited by it are—wheat, barley, beans, peas; and of root crops—potatoes, mangolds, turnips, especially the second, which contain a large proportion of salt in their composition. Professor Way estimates, from analysis, that while the turnip contains 2 lbs. per ton of salt, the mangold contains 6½ lbs. per ton of bulbs.

Salt is of essential benefit in killing weeds on the fallows, on which a very liberal dose may be applied, as the rains will have washed it down by the time it is necessary to sow the field. For this purpose it should be applied early in the morning or late at night, when these pests are most active.

But besides the application of salt as a dressing for the land, it is useful in an infinite variety of ways, of which comparatively few English farmers avail themselves. On the Continent all kinds of vegetables, as peas, beans, cabbages, cucumbers, &c., are preserved through the winter months merely by salting them, and by this means any family which has a garden can enjoy those vegetables all the year round which commonly are purchased of the market gardeners at prices that preclude the middle class from availing themselves of them. In pickling French beans they should first be sliced as for cooking, then to every layer of 4 inches put one of half an inch of salt, until the barrel is filled. Then put on an inside cover, weighted with a stone or an iron weight, to compress them, and let them stand for a month. About this time fermentation will have taken place, and a layer of beans partially decomposed is found at the top of the cask. These should be taken off, and the cover and stone well cleansed before putting them on again, a clean cloth being placed under them. Every three weeks or month this cloth should be washed and replaced. Before using the beans the salt should be mostly washed from them with cold spring water, and they are then fit to be cooked in the usual manner. By a similar process all other vegetables may be preserved for use during the season when they can only be procured at great expense.

* Thus, according to Berthollet, in a calcareous soil salt is gradually decomposed by the carbonate of lime which the soil contains. By this action, carbonate of sodium and chloride of calcium are formed—the first having the property of dissolving silica, and prepares it for the plants, of many of which it is an important constituent. Carbonate of soda is also a solvent for phosphoric and other acids, and thus prepares them for assimilation by the plants.

As a condiment for cattle salt has become an indispensable article on every modern farm. All animals are extravagantly fond of it, and will follow their tender all over the yard to obtain it. Although possessing in itself no inherent fattening properties, it acts beneficially upon the food, so as to render it more nutritive; and it corrects the impurities in the blood in animals, keeping them in health and giving them more appetite and zest for their food. By its antiseptic properties it preserves them from various epidemic and endemic diseases, commonly arising from impurities and a tendency to putrefaction in the blood of *high fed* animals particularly, but all receive benefit from its use.

Nor does the benefit of salt end here. There is not a doubt that manure made from the dung of animals which have had rations of salt daily, is more valuable than from that where salt has not been used. Thus, although, according to Boussingault, salt possesses in itself no nutritive properties, it stimulates the animal system and tends to increase the fattening properties of other food. Mixed with farm-yard manure also, in the proportion of four or five hundredweight to every thirty loads of manure, it has a very beautiful effect. By itself it is found an excellent preparation for wheat and barley, at the rate of from 10 to 20 bushels per acre. It not only gives strength to the straw, but it increases the yield of grain considerably, by checking a tendency to a too florid vegetation, whilst it gives greater firmness to the roots.

The application of salt to the land is less necessary near the sea-coast than inland. The air from the sea is always charged with this mineral, and the winds landward convey it in abundance to the adjacent fields, especially during storms.* Almost all rain-fall in an insular country like England contains a more or less quantity of salt. Dr. Madden has shown by analysis that in the average rain-fall of 31 inches at Pennicuik, in Scotland, it brought down upon the land of that vicinity no less than nearly 6 cwt. (641 lbs.) of salt per acre. We may, therefore, conclude that lands exposed to the sea breezes are sufficiently supplied with salt without an artificial application of it.

Salt is of great use to the farmer in a damp hay harvest, to prevent the hay from getting mouldy on the stack. It should be sprinkled over every layer or *dace* of hay in the proportion of from 28 lbs. to 10 lbs. per ton, according to the condition in which it is stacked. There are seasons when it is impossible to get the hay dry enough to be stacked alone safely; in which case the addition of salt will both preserve it and render it more nutritious for the animals.

Salt, according to Berthollet, when applied to a calcareous soil, is decomposed by the carbonate of lime; and, by a double decomposition, carbonate of soda and chloride of calcium are formed. Now, carbonate of soda dissolves silica, and thus a larger supply of that element is prepared, which enters so abundantly into the composition of the stalks or straw of cereal plants. This accounts for the fact that wheat and barley on land dressed with salt are less liable to be laid than on that where no salt has been used. Carbonate of soda is equally a solvent for phosphoric acid and other acids, and consequently, as one of the representatives of salt in the soil, supplies the plants with these essential elements of nutrition in greater abundance.

* When residing within not less than four or five miles of the coast, the writer has frequently observed the glass of the windows spotted with salt during a storm with the wind landward.

SECTION VII.

FARM-YARD MANURE.

Farm-yard manure is formed out of the produce of the land, as straw, chaff, hay, grass, corn roots, &c., whether used as litter or consumed as food by the animals of the farm. Formerly this was almost the only kind of manure used, and little trouble was taken to preserve its more valuable properties. The grand object was to promote decomposition as much and as quickly as possible. No effort was made to retain the volatile and other ingredients, the copious escape of which, indeed, was made the test of the goodness of the composition. If the "muck" had but a strong smell it was considered a certain proof of its goodness. And so it would be, were the *causes* of the smell preserved in the body of the manure; but their escape into the atmosphere involve a loss of the most valuable part—the ammoniacal and phosphoric matters so essential to the healthy vegetation of the plants.

Chemistry has gone far to correct the erroneous practices of agriculturists in this respect as well as in many others; and the box-feeding or stabulation of cattle is usually accompanied with arrangements for preserving the dung as well from the effects of rain as from the escape of the volatile salts, which would otherwise fly off during the process of fermentation. Many farmers now use a chemical preparation for fixing the ammoniacal substances in stables and cattle byres, where the escape is so great and the effluvium often so strong as to affect the eyes and the breathing of a person on entering a stable that has been closed during the night,* especially if the place is not properly ventilated, which is too frequently the case.

Fermentation, however, is necessary to prepare animal and vegetable substances for becoming the food of plants. Without it they would remain in a crude state, in which it would be impossible for the plants to assimilate them. In the process of fermentation they become decomposed and separated, and if allowed to evaporate, the greater part will fly off in various gaseous forms, and unite with their kindred substances in the atmosphere. There are only two principal agents in the composition of farm-yard manure—the straw or litter, and the dung produced by the animals from the consumption of food. There is a considerable difference, however, in the relative value of different kinds of straw, and a still greater in that of the dung, according to the nature of the food on which the animals have been kept. The following is the composition of different kinds of straw:

	Carbon.	Hydrogen.	Oxygen	Nitrogen.	Ashes.	Total.
Wheat straw .	48·4	5·3	38·9	0·4	7·0	100
Oat straw . .	50·1	5·4	39·0	0·4	5·1	100

* A very simple method of rendering the escape of ammonia in a stable valuable may be practised by any farmer. Place plates with common salt about the stable during the night. These will attract and fix the ammonia, which will be shown by *a strong effervescence*. This will continue until the salt is saturated and can absorb no more. It is then the *sal ammoniac* of commerce, and if preserved in bottles, has always a market price with the chemists.

The ashes of these straws are composed as follows, according to the analysis of three eminent chemists :—

	Ashes of Wheat Straw.		
	Berthier.	Boussingault.	Fromberg.
Potash	10·36	9.56	15·52
Soda	—	0·31	—
Lime	5·36	8·33	4·58
Magnesia	—	5·19	2·45
Oxide of iron	2·32	1·04	1·56
Phosphoric acid	1·12	3 22	2·92
Sulphuric acid	0·44	1·04	10·59
Chlorine	2·82	0·62	1 56
Silica	77·00	70·19	60·58
	100·00	100·00	99·76

	Ashes of Oat Straw.	Ashes of Barley Straw.	
	Boussingault.		Fromberg.
Phosphoric acid	3·0		3·10
Sulphuric acid	4·1		1·00
Carbonic acid	3·2	Oxide of iron	1·00
Chlorine	4·7		0·60
Lime	8·3		8·50
Magnesia	2·8		5 00
Potash	24·5		9·20
Soda	4·4		0·30
Silica	40·0		67·60
Alumina	2·1		—
Moisture and loss	2·9		3·70
	100·0		100·00

The second material—the dung or excreta of the animals—exhibits a much greater variety and value in its composition, according to the description of food on which they have been kept. Thus, the dung from green and root crops is less valuable than that from hay, and this latter than that from oil-cake or corn. These latter contain a larger portion of the elements of fertility, which are thus returned to the soil instead of being sold off the farm. There is also a difference in the relative value of dung from the various animals. As in the composition of the dunghill all these are generally mingled together, the fertilising value of the heap will be in proportion to the predominance of one or the other in making it up; and, as the accumulated manure of a homestead would require more room than can be commonly given to it on the spot, it is usual to cart it out of the yard, and form a heap in the field where it is intended to apply it. The manure should be transferred from the carts to the heap as speedily as possible, to close it against the air, and prevent the escape of the gases which contain the elements of fertility.

In finishing off a dunghill, it should be left as square and firm as possible, and covered over with mould to the depth of half a foot. This covering will receive and retain the steam arising during the fermentation of the dung. If salt is mixed with the mould, it will materially assist this operation, besides adding to the efficiency of the manure when the whole heap is mixed together and laid on the land. Morton recommends sprinkling the surface of the dung-heap with sulphuric acid as the most effectual method of arresting and retaining the volatile alkaline gases. Every kind of vegetable substance may be used in the composition of farm-yard manure—such as stubble, potato-haulm, turnip, and mangold tops, &c. These are valuable auxiliaries when thrown into the straw-yard to be trodden by the cattle. Weeds of all kinds, also, provided they have not ripened their seeds, may be profitably added, and will thus be made to return to the soil what they have surreptitiously taken from it.

When manure is carted into the field early in the season—which is often the case during a hard frost, for the sake of employing the men and horses, as well as for executing the work while the ground is hard, and consequently less liable to injury from the operation—the dung-heap will require one or more turnings over to complete the decomposition. The more the different kinds of manure are mixed together, the better will be the aggregate. There are, however, some crops which are most promoted by certain manures. Thus, horse-dung is the best for potatoes, whilst cow-dung is adapted to turnips, being of a cooler nature. Pig's dung is of so hot a nature that it is better it should at all times be mixed largely with others in the heap, where its strength will be tempered by those of a colder and less powerful kind.

The manure should be carted to the fields in the order in which they are to be sown or planted. Thus, the potato will require the first carting; then the mangolds and turnips; and lastly the autumn-sown wheats, whether upon the first year's lay or on the bare fallow. This latter is now only admissible when the land is foul with weeds, requiring a summer-tillage to destroy them. If the fields are large it will be better to have two dunghills, in order to lessen the labour when it is of most value to the farmer. If possible, the heaps should be placed on the highest part of the field, in order to lighten and expedite the work of distribution when it is wanted.

Stephens, in his "Book of the Farm," has some excellent observations on the loss of time frequently incurred in carting out manure from the farm-yard, in consequence of the carelessness exercised in distributing the straw and dung from the stables in the straw-yard. Straw ropes are thrown in whole, and probably at full length; barrows-full of horse-litter rolled up and laid in heaps; no regularity of spreading observed, with the view of lightening the labour of loading it when removed to the field. From what we have experienced of this neglect, we estimate the loss of time at not less than from 5 to $7\frac{1}{2}$ per cent. from this cause—a serious loss to the farmer, and equally to the labourer when upon piece-work, and much more laborious to him to accomplish. Dry weather, if there has been no frost, is indispensably necessary for carting dung into the field.

In forming the dunghill in the field, every fork-full should be hard trodden down, being spread as equally and as level over the whole surface as possible. A man should be employed expressly for this work, which should not be left to the carter, who is always in a hurry to get back for his next load. The treading and compression of the heap will retard the fermentation, which toward the spring, when the temperature rises, begins to act powerfully. At 65° Fahr. the second fermentation or decomposition takes place, the first having taken off only the aqueous portions of the vegetable compound whilst the second destroys the fibre and liberates the gases.

Some farmers cart the manure on to the fallows at once from the yard, and plough it in when the state of the land allows it. It requires, however, to have the soil free from weeds to do this; otherwise there is, no doubt, this advantage in it, that the manure becomes more intimately mixed with the soil, and is less likely to render the wheat too florid, which is sometimes the case when the manure is put on at the time of sowing. The convenience of the farmer must determine the eligibility of this plan in some degree; but it appears reasonable that when manure is laid on long previously to the time of sowing, a considerable portion of its most valuable matters will be dissipated and lost. This will especially be the case if the manure is allowed to lie in heaps on the field, waiting for dry weather, to be ploughed in, which is not unfrequently the case. By this means its value becomes greatly lessened by the evaporation of the volatile salts, and the action of the rain upon it, which carries off the soluble portions. This, too, is effected without fermentation, the heaps not being sufficiently large to admit of their gathering heat.

Many farmers now have dung-pits, into which the manure from the stables, cattle-byres, and pigsties, is thrown as it is made. Stephens approves of this method of making the manure, and gives an instance of it which came under his own observation. The pit was formed in the yard, and was covered over with thick planks, on which earth was laid, and a pavement or trap-door was left to throw in and take out the dung. The litter and excreta of thirty horses were thrown into the pit. The yard itself was covered in to prevent the rain from getting in; yet in summer the whole mass was fermented and got into a state for use within ten days or a fortnight, and in winter in three weeks. The heat was not so great as on some dunghills, nor was there, on its removal, any perceptible escape of ammonia, only the aqueous fermentation having taken place. On the other hand, the heat generated in the fermentation was not liable to be dissipated, as that of a common dunghill would be, because every part except the top was enclosed from the action of the air. By this means the temperature was as well preserved in winter as in summer, which is an undoubted advantage. It is to be remarked, however, that this case was not connected with a farm, but with an establishment belonging to a carter, who kept the number of horses above stated, and, of course, sold the manure when it was ready. There is no reason why it should not answer the purpose as well upon a farm, except that the farmer is more dependent upon times and seasons, and is usually driven by weather to adopt the shortest and most direct method of accomplishing an object.

Stephens recommends, or rather suggests, the plan of having a dung-pit erected at the corner of four fields, if it can be so arranged. The walls to be of stone and lime, 6 feet above and 3 feet below the level ground. The shed should be drained all round to keep out the rain-water, and the floor well puddled to retain the dung-water. A shed 10 feet wide, 9 feet deep, and 150 feet long, will contain 13,500 cubic feet of dung. Such a shed, placed at the angle of four fields, would serve the purpose of all of them. Stephens admits that this will occasion much more trouble and labour than the common dung-heap; but that the increased value of the manure will more than compensate for it.

Dung-pits are much in use in Flanders and Belgium, and are usually placed by the sides of the highways, for the convenience of cartage. We have already given an account of these in speaking of the agriculture of Flanders; it is therefore unnecessary to repeat it.* That they have never until lately been proposed for adoption in this country is to be ascribed to the strong prejudices of the farmers formerly to innovating practices. This disposition is happily a thing of the past, and the modern farmer is as much alive to improvement and open to conviction as any other class.

Horse-dung ferments much more readily than cow-dung, and should therefore be removed from the stables daily, fermentation taking place in twenty-four hours. If left in a heap for two or three weeks it will have lost three-tenths of its weight; whereas cow-dung, after lying forty days, loses only one-fifth. The latter is of a more watery nature, consequently evaporation is greater than fermentation; and it should be sheltered

* See pp. 174 to 176.

carefully from the rain and sun. The following is the analysis of cow and horse dung:—

	Fresh Dung. Cow.	Fresh Dung. Horse.	Dry Dung. Cow.	Dry Dung. Horse.
Water	90·60	73·31	—	—
Nitrogen	0·22	0·54	2·3	2·2
Saline matters	1·13	4·02	12·0	16·3

Professor Johnston considers pigs' dung to be colder and less fermentable even than cow-dung; but Stephens has found it a hot and excellent manure; and this agrees with the former experience of the writer, and with the nature of the food given to pigs. Boussingault gives the following analysis of this manure:—

	Fresh.	Dry.
Water	81·00	—
Nitrogen	0·63	3·37

Pigs' dung requires to be mixed with a large proportion of other manure if used for corn, it being too strong of itself. Sheep-dung is drier than any of the foregoing, and is richer in nitrogen. The following is Boussingault's analysis of it:—

	Fresh.	Dry.
Water	63·0	—
Nitrogen	1·11	1·99

The dung of young animals is less valuable than that of older ones. Thus, the urine of a calf fed on milk contained only 1 lb. of solid matter in 1,000 lbs., whilst that from a full grown cow contained 80 lbs. of solid matter and 8 lbs. of nitrogen in the same quantity.

The following analysis of 1 ton of prepared farm-yard manure is given by Professor Tanner, in the *Journal of the Bath and West of England Society*:—

	Fresh Dung.		Well-rotted Dung.		
	Number of lbs. per ton.	Value.	Number of lbs. per ton.	Value.	Price per lb.
		s. d.		s. d.	
Water	1482¼	—	1689¼	—	—
Soluble organic matter	55½	2 0	83	4 0	Ammonia
,, inorganic matter	—	—	—	—	6*d*.
,, silica	5¼	—	5¾	—	—
Phosphate of lime	6¾	0 5	8½	0 6½	¾*d*.
Lime	1½	—	2½	—	—
Magnesia	¼	—	1	—	—
Potash	12¾	3 3¾	10	2 9	—
Soda	1¼	—	½	—	3 3-10ths.
Chloride of sodium	¼	—	¾	—	—
Sulphuric acid	1¼	—	1¼	—	—
Carbonic acid and loss	4¾	—	2¾	—	—
Value of soluble matter	—	5 8¾	—	7 3½	—
Insoluble organic matter	577	6 9	287¼	4 3	Ammonia
,, inorganic matter	—	—	—	—	6*d*.
Soluble silica	21¾	—	32	—	—
Insoluble silica	12½	—	22½	—	—
Oxide of iron and phosphates	13½	0 6½	21¼	0 8¾	Bone-earth
Lime	25	—	37½	—	¾*d*.
Magnesia	3¼	—	2	—	—
Potash	2¼	0 7½	1	0 3½	3 3-10ths.
Soda	½	—	¾	—	—
Sulphuric acid	1¼	—	1½	—	—
Carbonic acid and loss	10¾	—	29	—	—
	2240	7 11	2240	5 3	—
Value of insoluble matter	—	7 11	—	5 3	—
Value of soluble matter	—	5 8¾	—	7 3½	—
Total value of a ton of manure	—	13 7¾	—	12 6½	—

The proportions of these elements will, of course, vary according to those of the sources from whence the materials are obtained, and the care exercised in their preparation. Manure made under cover is more valuable than that made in an open yard, exposed to rain and the powerful evaporation of the sun; although this latter, in the first instance, only draws off the aqueous portion, the liberation of the volatile alkalies by the decomposition of the manure only taking place on the second fermentation.

The introduction of box-feeding of cattle is considered not only to be a great improvement as it regards the economy of food, and the quicker preparation of the animals for the butcher, but also as it regards the superior quality of the manure. In this system none of the dung or urine is removed, but is trodden down by the animals, fresh litter being constantly supplied to them, to be consolidated into a substantial mass, which retains all the urine and other liquid matters of the *excreta*. Much, however, even in this system, depends upon the quality of the food, the age of the animals, and their condition, when put up to fatten. A half-fat animal will produce much better manure than a lean one. The latter extracts and assimilates more copiously the nourishment of the food, leaving the *excreta* very inferior to that from one approaching to the required degree of fatness. At present, however, this question is under discussion; and many practical men doubt whether the system, all things considered, has that advantage over open feeding which its advocates so loudly assert. That a bullock will fatten faster thus confined than when at liberty, may be correct; but whether the meat will possess equally good qualities is doubtful. A series of analyses and experiments are still required to set this question at rest. The following analyses were made at the laboratory of the Royal Agricultural College at Cirencester:—

Dried at 75° Fahr.

	Box manure, per cent.	Common farm-yard manure, per cent.
Nitrogen	1·95	1·4
Equal to ammonia	2·37	1·70
Organic matters removable by water	6·44	1·82
Inorganic matters removable by water	4·28	2·78
Consisting of the following substances:—		
Phosphoric acid	0·30	0·21
Potash and soda	2·00	0·80
Lime	traces	traces
Silica—quantity not determined	—	—

Before drying, they contained, respectively, of water, box manure 71·04, and common farm-yard manure 71·00 per cent.

From these results, the box manure has the advantage in the retention of the more valuable elements of fertility both soluble and insoluble in water. It requires further experiments fully to determine, at least, the extent of the advantage, both manures being made under equally favourable circumstances, which does not appear to have been the case in this instance. Certain it is, that the confined space occupied in box-feeding causes the manure to become more compressed and dense, which excludes the air to a great extent, and, consequently, retards the process of fermentation; and, on the other hand, the wind and rain are also excluded, which too frequently, in an open yard, alternately rapidly evaporate and supersaturate the mass of manure, especially if the adjoining buildings are not furnished with troughs at the eaves, to carry off the water.

There is an opinion very prevalent amongst farmers, that in order to render vegetable produce valuable as manure, it is necessary that it should pass through the stomach of some animal, which imparts to it certain properties it does not otherwise contain. This is entirely a mistaken notion; for whether it is consumed or returned to the soil in the natural state, it is equally valuable as a manure, provided it becomes decomposed. Indeed, in the latter case the benefit is greater, because when used for food a considerable portion of the elements of production are carried off by the animals which have eaten it; whereas, if ploughed in, the land receives the entire benefit of it. The late Mr. Nesbit, in his lectures, has given several practical instances of the beneficial effects of breaking turnips in pieces in the spring, before they run to seed, and ploughing them in for the barley. In one instance in which they were thus treated in part of a field, whilst on another part they were drawn off the land, the produce of the first was 84 bushels of oats per acre, and of the second only 41 bushels. A part of the field was fed off by sheep, and on this the produce was only $70\frac{1}{4}$ bushels. Other farmers, in their letters, estimate the increase of barley at 3 sacks of 4 bushels each per acre; the after-crops also were better in every respect. This plan, however, is only advisable in case the farmer has more turnips than his sheep and cattle can consume, under which circumstance it is not unusual to allow a neighbour to feed, or even to draw them off, rather than they should be lost. We have frequently seen fine turnips thrown in heaps in ditches or on waste land, in order, as the owner expressed himself, "to get them out of the way of barley-sowing," when, had they been broken up and ploughed in, they would probably have increased the after-crops to the extent of from 25 to 15 per cent. each. If, however, the farmer has cattle enough to consume them on the ground, the present price of meat will make it more economical to devote them to that purpose. This is easily estimated. One ton of Swedes has been found to make 14 lbs. of mutton, and 1 ton of Whiteloaf turnips 10 lbs. Reckoning a crop of the Swedes at 21 tons, and the Whiteloaf at 28 tons. the account will stand as follows:—

21 tons of Swedes	× 14 lbs.	=	294 lbs.
28 „ Whiteloaf	× 10 „	=	280 „

The present price of the best mutton is $6\frac{1}{2}d.$ per lb., therefore,

294 lbs.	× $6\frac{1}{2}d.$	=	£7 19 0
280 „	× $6\frac{1}{2}d.$	=	£7 0 0

SECTION VIII.

ANIMAL MANURES.

Bone-dust.—Bones were, we believe, first used in England for manure in Cheshire. About the middle of the last century, the Cheshire farmers employed them upon old pasture-lands at the rate of $1\frac{1}{2}$ ton per acre. They were broken with a heavy hammer or mallet, and of course were spread in a very rough state. In some cases, they charred the bones before applying them, and found it greatly improved the pasture-lands in that state. About the beginning of the present century, the use of bone manure began to be common in England, but its intrinsic value could not be discovered until means had been found to reduce the bones to a state in which decomposition, and the consequent liberation of the volatile salts, could take place. The bone-mill was very soon invented, by which means, instead of $1\frac{1}{2}$ ton of imperfectly broken bones, 5 or 6 cwt. of bone-dust was found to be an ample and durable dose. Even in this form, the slowness of the decomposition caused the phosphates and ammonia to be given out so deliberately, that the quantity stated lasted several years, continuing to give out its volatile salts to the last. We have already shown that about 85 lbs. of bones contain phosphates enough for a crop of wheat of 5 quarters per acre; consequently, if that quantity can be presented to the wheat in a form in which the crop could reap at once all the benefit of it, bones would be the cheapest manure that could be invented. It is a question whether the conversion of bones into superphosphate has not solved that problem; and, by causing the instantaneous decomposition of the bones, reduced them to a state in which all the elements of fertility they contain are at once available and assimilable to the plants.

Bones are found to contain half their weight (or nearly so) of phosphate of lime. There is, however, a great difference in the composition of bones, those of young animals containing much less phosphate than older ones. Sheep bones, also, are less valuable than cattle bones, which latter are also considered more so than those of the horse. Fish bones are inferior to all these,* and produce a very weak effect upon the crops, whether of wheat or turnips.

All bones collected by the merchants are boiled before they are crushed, in order to obtain the fat which constitutes the chief part of the profit. Horse bones are an exception, their bones being solid, containing very little fat. For this reason horse bones are purchased at a very inferior price by the bone merchant, and being mixed with the cattle bones, pass to the consumer at their full value. It is a question, however, whether they are not, *unboiled*, as good for the purpose of manure as the *boiled* cattle bones. We are not aware of any analysis that will throw light upon this subject; but in purchasing large quantities of bones for crushing, the writer has always objected to horse bones, under the conviction that they were less useful. It is said that the process of boiling does not deteriorate the agricultural value of the bones. The question is, whether the fat contains any properties proper for the nutrition of vegetables. We find all plants, upon analysis, contain a small portion of fatty matters; from which we conclude that the same substance in animals is derived from vegetable food, and that, therefore, to deprive the bones of it, must do them an injury as manure. But besides the extraction of the fat, a very considerable quantity of the animal gelatine is also extracted. This, when purified and reduced to a certain state of solidity, is sold to the Manchester manufacturers, who employ it in stiffening their cotton fabrics. This reduces the proportion of nitrogen in the residue of the bones, which are further deteriorated by being laid in heaps of from 100 to 200 tons, in a wet state, as they are taken from the boilers. They there ferment and throw off a further portion of the volatile salts; and having heated themselves dry, are then prepared for sale

* We know an instance in which a bone-crusher purchased a large quantity of whales' bones of the captain of a whaler, who had brought them home on speculation. Our friend mixed them freely with his cattle bones; but the mixture was found to be so inferior in effect, that he lost nearly all his trade by the speculation.

to the crushers. The following is a series of analyses made by Dr. Voelcker, of the Royal Agricultural College at Cirencester:—

ANALYSES OF HALF-INCH BONES.

	1.	2.	3.	4.	5.	6.
Moisture	13·58	16·42	13·18	13·36	9·16	11·17
Organic matters, gelatine, and fat	33·69	23·64	27·92	28·32	29·20	34·95
Phosphate of lime and magnesia	42·77	49·78	48·24	48·49	52·06	47·50
Carbonate of lime	7·04	6·51	9·66	8·10	6·11	4·53
Alkaline salts (chiefly common salt)	2·00	1·17	1·62	2·18	2·88	1·61
Sand	0·92	0·00	0·00	0·00	0·17	0·00
	100·00	97·52	100·62	100·45	99·88	99·76
Containing nitrogen	4·28	3·43	3·21	3·45	3·62	4·18
Equal to ammonia	5·23	4·18	3·89	4·18	4·39	5·08

ANALYSES OF QUARTER-INCH BONES.

	1.	2.	3.
Moisture	18·12	17·00	9·82
Organic matters, &c.	29·29	30·54	37·50
Phosphate of lime and magnesia	44·22	34·41	45·46
Carbonate of lime	5·49	8·56	5·23
Alkaline salts, &c.	1·49	2·56	1·96
Sand	1·39	6·98	0·00
	100·00	100·05	99·97
Containing nitrogen	—	—	4·15
Equal to ammonia	—	—	5·03

In estimating the value of improvements on taking a farm, a dressing of bone-dust is calculated to last over three white crops. If, therefore, only one crop has been taken, it is considered two-thirds of the value of the bones remain in the land; if two crops, then only one-third remains for the incoming tenant to pay for. This is strictly a just principle to act on in such cases, because bones in a crude state, however finely pulverised, decay so deliberately that it requires several years of cropping to exhaust the elements of fertility they contain. We have shown, in p. 692, the quantity of bones required to supply a crop of wheat with phosphoric acid, supposing that it could all be liberated for the use of that one crop. If, then, four or six times that quantity is used in the crude state, they would continue to give out phosphoric acid and ammonia until entirely decomposed and reduced to bone-earth, all the volatile and soluble salts being by that time liberated.

Bones are commonly made use of for the turnip crop, which is certainly the most economic application of them. Whilst they prove a powerful stimulant to the young plants, they are not exhausted by them, as root and green crops require much less phosphate than white crops. A dressing, therefore, of bone-dust, if applied to the turnip crop, will last the whole course of cropping; and the wheat, which comes last (generally speaking), finds ample nourishment left in the soil to support it to maturity. The usual quantity applied for turnips is 16 bushels, of 42 lbs. each, or 6 cwt.; and it is worthy of observation that an increase of the quantity has no perceptible effect in increasing the crop. This proves that the turnip can only take up and assimilate a certain amount of those matters contained in the bone-dust. Mr. Stephens made experiments by using from 12 to 24 bushels for turnips; and he found that the crop improved up to 16 bushels, but beyond that quantity there was no perceptible effect. He mentions also a case in which 8 bushels of bone-dust, mixed with an equal quantity of sifted dry coal-ashes, produced as good a crop of turnips as 16 bushels of bone-dust without any ashes.

A great improvement has been effected in the application of bone-dust, as well as other manures, by the invention of the combined drilling machines, which deposit the bone-dust at the same time as, and under, the turnip seed. As this manure has nothing of a caustic nature in it to injure the vitality of the seed, it is a great advantage to have the latter in immediate contact with the manure. A slight fermentation of the bone-dust takes place after it is exposed to the moisture of the soil, producing a degree of warmth which greatly promotes the vegetation of the seed. Bones, for turnips, should in all cases be reduced to as fine a powder as possible, the young plants in the first stages of existence being small and tender, and requiring the immediate aid of the manure to promote their growth. Inch or ½-inch bone would not have this effect; and as the turnip has only a few months to mature itself, the first stages of its growth are of the most consequence, as the sooner the rough leaves of the plants appear, the quicker will it get out of the way of the fly and other enemies.

Superphosphate of Lime is a preparation from bones treated with sulphuric acid, and has introduced a more economic use of bones. In this case the bones are decomposed and reduced to a gelatinous or pulpy mass, which, being mixed with dry saw-dust, or coal-ashes, or dry vegetable mould, may be drilled or sown with the seed. 200 lbs. weight of bones, treated with 100 lbs. of sulphuric acid, diluted with 200 lbs. of water, is sufficient for an acre of land; and if mixed with farm-yard manure, 1 cwt. of bones, 56 lbs. of oil of vitriol, to 10 or 12 tons of dung per acre will be sufficient for the crop. Mr. Pusey recommended the following method of treating bones for manure: Mix 4 cart-loads of bones with the same quantity of sand, mould, or saw-dust, in a flat-topped heap. The bones should be fully saturated, and the other material moistened, with water. In a few days, such a heat will be generated as to render it unbearable to the hand. Cover the heap with sand, to keep in the heat. If the heap is turned over at the end of a fortnight and again watered, the largest bones will have been dissolved at the end of a month; and if broken small, they will take much less time. Mr. Pusey found that 8½ bushels of bones thus treated, produced as good a crop of turnips as 17 bushels of bone-dust at double the cost; and that by increasing those quantities one-half, no benefit to the crop was perceptible. The following is the process recommended for manufacturing the superphosphate of lime, or as Stephens calls it, "sulphated bones:"—

The bones may be dissolved either in a tank (whether of wood, zinc, or iron), or on a heap of ashes in the open air. As this latter mode is the least expensive one, and may be conducted on any scale without a costly apparatus, we shall describe it:—

"First lay a platform of ashes, well screened, in the field you intend to manure. Calculate the quantity *per acre* to be applied, and multiply it by the number of acres. The platform must be 12 feet wide, 1 foot deep, and in length according to the extent the ashes will reach. The ground under the heap should be perfectly level and hard, and the centre of the ashes, to the extent of 6 feet, should also be beaten or trodden hard, as on that part the bones are to be laid, and the acid also would otherwise escape through the ashes. This is a main point in the process.

"The bones having previously been crushed in the ½-inch mill, must be drawn alongside the heap in bags, and emptied on the centre of the ash-heap or platform, where it has previously been trodden hard, allowing them a base of 5 feet, so that 6 inches of the solid floor of ashes remains on each side. Lay on the bones so as to bring them to an angle of 45° with the apex. When they are all laid on, bring the water-cart alongside, and with a common large watering-pot saturate the heap of bones all over until they have absorbed as much water as they will hold. The excess will flow through them into the rim of hard ashes left at the side of the bones. This watering should be repeated thrice, on separate days, taking care each time to water them as evenly as possible. They will of course require less and less water each time; and always leave off as soon as the water begins to flow in the gutter. On the fourth day, the bones being ready for the acid, lay about 3 inches thick of ashes at the foot of the bone-heap, beating them hard, to prevent the acid from escaping. Then bring the carboys to the side of the heap, and have ready a large, new, or, at any rate, perfectly sound watering-pot, with a rose to it, the holes in which must be examined to see that they are quite open, so that the acid may flow freely from them. Two men must then take a carboy, and, removing the stopper, place it about a foot high on a heap of ashes, or anything else that is handy. One man must hold the water-pot, while the other gently pours out the acid, filling the pot three parts full. This must be poured evenly over the bones, the man walking on the 3-foot border of ashes. When half the quantity required is applied (that is, in the proportion of 120 *lbs. of the best oil of vitriol to each quarter, or* 8 *bushels of bones*), the heap will begin to smoke, bubble, and shrink down visibly. The remainder of the acid must then be applied as quickly as possible. Then the men, with their spades, must begin at one end to cover the heap with the ashes on the border, beating them hard, and bringing them to a ridge at the top, to prevent the steam from escaping, or the wet from penetrating. As soon as the water-pots are done with, wash off all the acid, both within and without, which will prevent them from taking injury from it.

"The heap must stand a fortnight before it is disturbed. It must then be turned carefully four or five times, thoroughly to mix the dissolved bones and the ashes, breaking the lumps as you proceed. If the heap were to remain a month or two, it would make the manure much better, taking care, if it be done in a rainy season, to cover the heap with thatched hurdles to keep off the moisture."*

Superphosphate, made in the above manner, is being extensively and successfully used in Hampshire and the adjoining counties. One bushel of superphosphate has been found equal to 4 bushels of crude bones; and Nesbit states that it will produce some effect on the crops of future years.

The remarkable, but well-established fact, that where bone-dust is sown upon grass-land, white, or Dutch clover invariably springs up in abundance, has caused much discussion and conjecture as to the cause of such a phenomenon. At first, the farmers concluded that imported bones must have contained the seeds, and that they had thus got disseminated through the masses of bone-dust. The fact that boiled bones produced the same effect staggered those who had entertained this opinion, and science has explained the mystery in a more reasonable and satisfactory manner. A chemical

* See a pamphlet entitled "Agriculturists their own Superphosphate Makers, &c.," by A. G. Lock, Vitriol Works, Southampton.

analysis shows that white clover contains a large portion of phosphate of lime, and that soils destitute of that material give no encouragement to its growth, and even where sown, it remains in a weak state, smothered by the coarser grasses. Bones, then, supply this constituent; and therefore, wherever they are employed as manure on pasture, this plant instantly avails itself of it, and acquires a vigour which enables it to exterminate its former rough rivals. Almost all the soils of England contain the seeds of the white clover. We see it spring up by the sides of roads, and in other positions where it is impossible that it ever should have been sown otherwise than by nature. It is said that after the fire of London the site of the ruins became covered with white clover. This was accounted for by the dispersion of the lime from the destroyed buildings, causing the seeds of the white clover to vegetate after being buried for centuries.

It may be supposed that the action of superphosphate on vegetation is much more rapid than that of bones simply ground. In fact, the process of decomposition, which, if left to nature, would require years to complete, is by the application of the acid effected in a few weeks; and by it every alimentary portion of the bones is rendered available to the plants. A small quantity, therefore, of this manure will produce as great an effect, if directly applied to the seed, as six or eight times its weight of crude bones. This is given upon the supposition that the constituent parts of the bones have undergone no diminution in the process, a question which we raised in p. 693, and which we now again recur to, namely, whether, in the process of dissolving bones with sulphuric acid, they do not lose at least a portion of their most valuable constituents? The following analyses will perhaps throw some light on this question:—

Analyses of Superphosphates and Bones.

	Superphosphates.		Bones.
	1.	2.	
Water	10·50	23·97	6·20
Organic matters	26·47	16·18	39·13
Phosphates	34·29	27·18	48·95
Sulphate of lime	12·14	11·39	—
Sulphuric acid	14·40	12·93	3·15
Alkaline salts	0·72	2·54	—
Lime	—	—	2·57
Magnesia	—	—	0·30
Silica	1·48	5·81	0·30
	100·00	100·00	—
Ammonia	3·17	1·32	4·48
Soluble phosphates	22·97	19·58	—

It appears, by these analyses, that while the superphosphate contains an average of about 17 per cent. of water, the proportion in bones is only 6·20. This is easily accounted for, not only by the water with which the sulphuric acid is mixed in the process, but the acid itself has so strong an affinity to water, that when left exposed to the atmospheric currents it will attract the moisture, and thereby increase its bulk indefinitely. On the other hand, the organic materials, which in the two analyses of superphosphate average about 21 per cent., figure in bones at 39·13 per cent.; and while the phosphates in the first average about 30·50, those of the latter value at 48·95 per cent. The proportion of ammonia is equally superior in bone, valuing at

4·18 per cent., while that in the superphosphates averages only 2·25 per cent. The great advantage, therefore, in using the dissolved instead of the crude bones, is their being prepared for immediate assimilation by the plants, and, consequently, a smaller quantity is needed. It is probable, however, that the action of the acid in its highly diluted form, by which its more caustic properties are modified and reduced, exercises an important influence on the plants by the increased temperature it creates in the soil. One and a half cwt. of superphosphate is equal in immediate effect to four times its weight of crude ground bones, but in real value is not worth more than 1 cwt. of bones. This should be taken into account when purchasing the superphosphate, and should induce the farmer always rather to purchase the bones, and manufacture the superphosphate himself, by which a considerable saving will be effected. Independent of this, some of the makers put in a considerable portion of lime and gypsum, which reduces its value, and is a fraud upon the purchaser. Large quantities are also made from fossil bones, or coprolites, which are found in various parts of the country. Although the superphosphate made from these is efficient, it is less so than that made from fresh bones.

In manufacturing his own superphosphate, the farmer will have the advantage also of using *unboiled* bones, supposing he employs persons in towns to collect them for him. This is no trifling consideration when we remember that *all* the fat, and a large portion of the gelatine, is extracted in the process of boiling;* and although some of the bone-boilers throw the liquor from the pans over the heap of bones, still this is not equal to letting it remain in the bones and applying the acid to them, in their original state; and, at any rate, all the fatty matters contained in them are lost. By an experiment made by a French gentleman in 1844 of different manures on grass-land, it was found that gelatine from bones was the most productive. The following is the statement of the produce of one *hectare* of land (2 acres 1 rood 35 perches), with different manures:—

PRODUCE OF ONE HECTARE OF GRASS LAND IN TWO YEARS FROM DIFFERENT MANURES.

Manures.		1st Year.	2nd Year.	Totals.
	kilogrs.	kilogrs.	kilogrs.	kilogrs.
No manure	—	3·820	4·486	8 300
Sulphate of ammonia	250	5·564	4·170	9·734
Nitrate of soda	250	5·690	4·390	10·080
Nitrate of lime	250	5·397	4·420	9·817
Muriate of lime	250	3·830	4·110	7·940
Phosphate of soda	300	4·326	4·657	8·983
Burned bones	800	3·658	4·677	8·336
Gelatine of bones	500	6·383	4·923	11·306
Peruvian guano	600	6·360	4·703	11·063
„ „	300	5·403	4·826	10·229
Linseed oil-cake	800	4·420	4·660	9·080
Rape-seed „	600	3·393	4·509	7·902
„ „	300	4·043	4·810	8·853
Bran	800	3·853	4·273	8·126

* These matters contain the nitrogen, which, according to Schlieper, constitute 18·47 of the organic portion of bones. The following are the organic constituents:—

Carbon	50·50
Hydrogen	6·90
Nitrogen	18·47
Sulphur	0·56
Oxygen	23·57
	100·00

Thus, in the two years, the gelatine exceeded the lowest produce in the scale by 3,006 kilogrammes of grass, or upwards of 3 tons; and the highest next to itself, namely, the guano, by 243 kilogrammes, or 534 lbs.; which proves, plainly enough, the importance of retaining the gelatine in the bones.

Guano.—This now celebrated and favourite manure was, as we have stated, introduced into Europe about the year 1810. It was sold, in the first instance, at £20 per ton, and was found to be so powerful as a manure, that it was said to pay even at that high rate. It contains, indeed, such a condensation of the most valuable constituents, that a small quantity of it, applied in a direct manner, produces an extraordinary effect. Thus, in the West Indies, the planters make a hole midway between two cane plants, into which they put about half a pint of guano; and so powerfully does the ammonia extend itself, that the dressing is quite sufficient for the cane crop. The late Mr. Nesbit recommended it to be used with salt, in the proportion of 2 cwt. of guano and 4 cwt. of salt, to prevent the wheat from being lodged, which the luxuriance superinduced by the guano alone would be apt to occasion. The best Peruvian guano ought, according to the same valuable authority, to contain 16 or 17 per cent. of ammonia, and from 25 to 30 per cent. of phosphate of lime; but there are many other kinds of guano of a very inferior composition, not worth one-fourth of the Peruvian. The extraordinary qualities of this latter, undoubtedly, are owing to the circumstance, that the islands on which it is deposited are never subject to rain. On the adjoining mainland rain is almost a prodigy, a period of seventeen years having been known to elapse without a single shower. The consequence is, that the guano, which is a deposit of the dung of myriads of sea-birds, never has its soluble salts washed out; which is not the case with that which is brought from any other part.

The wonderful properties of this manure were not likely to escape the notice of the fraudulent traders in artificial compound manures. Spurious articles of the most worthless and villainous description were manufactured, and palmed off as genuine guano, but offered somewhat below the real kind. Sand, marl, clay, chalk, limestone, ground bricks, tiles, gypsum, and especially a reddish yellow earth found in abundance both near London and Liverpool, and approaching very near the colour of guano, were employed to a greater or lesser extent in manufacturing this manure, a small portion of the genuine article being added to give it the proper smell. Some of these dishonest traders having, upon being prosecuted, been cast with heavy damages, and the farmers having become rather more alive to the value of *cheap* guano, the trade is now almost cut up; and the facility for having the samples offered to them analysed, the buyers now have the matter in their own hands, and can, without much expense, ascertain the intrinsic value of a sample. The following is Mr. Nesbit's analysis of an average sample of Peruvian guano; and also the average of 32 samples analysed by Wens—

I.		II.	
Moisture	15·10	Water	13·00
Organic matter, &c.	51·27	Organic matter and salts of ammonia	52·61
Silica	2·20	Sand	1·54
Phosphate of lime	22·13	Earthy phosphates	24·12
Phosphoric acid (equal to)	3·23	Alkaline salts	8·73
Phosphate of lime	—		
Alkaline salts	6·07	Ammonia yielded by 100 parts	17·41
	100·00		
Nitrogen	13·54		
Ammonia	16·42		

The following analyses are still more minute, and were made by two eminent foreign chemists, of different kinds of guano—

	Oellacher. Brownish yellow Guano.	Bartels. Brownish red Guano.
Urate of ammonia	12·20	3·244
Oxalate of ammonia	17·73	13·351
Phosphate of ammonia	6·90	6·250
Ditto ditto and magnesia	11·63	4·196
Muriate of ammonia	2·25	6·500
Carbonate of ammonia	0·80	—
Humate of ammonia	1·06	—
Oxalate of lime	1·30	16·360
Phosphate of lime	20·16	—
Carbonate of lime	1·65	—
Chloride of sodium, or common salt	0·40	0·100
Sulphate of sodium	4·92	1·119
Phosphate of sodium	—	5·291
Sulphate of potash	4·00	4·227
Sand	1·68	5·800
Alumina	—	0·104
Waxy and resinous matter	0·75	0·600
Water and volatile ammonia, undefined organic matter and loss	12·57	22·918
	100·00	

The success attending the introduction of the Peruvian guano led to the search for it in other parts of the world, and deposits were discovered on the coast of Patagonia, at Saldanha Bay, on the south-east coast of Africa, and at Ichaboe, an island on the west coast of Africa. Of Peruvian guano there are two kinds, the *Angamos*, which is the recently deposited, and that from the old deposits. The former, which is collected by hand at a much greater expense than the latter, is also more valuable, as it contains a larger proportion of ammoniacal matters. It therefore fetches a higher price in the market. The rainless district, in which the best guano is found, reaches from the Chincha Islands, on which the largest deposits are found, to the coast of Bolivia, and comprehended between the 14th and 21st degree of south latitude. Beyond those limits the quality is very inferior, as the following table will show:—

	Average per centage of Ammonia.	Average per centage of Earthy Phosphates.
Angamos	21·10	17·22
Peruvian	17·41	24·12
Ichaboe	7·30	30·30
Patagonian	2·54	44·60
Saldanha Bay	1·47	56·46

Thus, while the Peruvian guano is extremely valuable on account of the large amount of ammonia it contains, the Saldanha Bay guano can only be purchased for its phosphate of lime, so that, while the former sells at from £9 5*s*. to £10 per ton, at the ships' sides, the latter averages about £5 per ton. That from Ichaboe is of intermediate quality, and fetches from £7 to £7 10*s*. per ton.

The increased importation of this manure is a proof of the estimation in which it is held by the agriculturists. In 1850 the quantity imported was 100,000 tons; and that of the two last years was respectively, in 1861, 178,423, and in 1862, 141,636 tons We believe that by far the largest portion of these quantities was the Peruvian, or the highest priced article; but if we take it at the average value between that and the Saldanha Bay guano, namely, £7 per ton, the British farmer has paid for this new and extra manure the enormous sum of £2,240,113 sterling in the two years, besides purchasing indefinite quantities of home-made artificial manures, bones, oil-cake of various kinds, and a multitude of other substances never thought of formerly. If we add to these the increased amount of farm-yard manure now made, by the increased production of root crops, and of cattle to consume them, it can no longer be said that the agriculturists are either penurious or sparing in their outlay for the improvement of their land, or the increase of their produce.

With regard to a prospect of a continuance of the supply of guano, so far as the Chincha Islands are concerned, there appears to be no fear of its being exhausted at present. There are three islands, each of which is about six miles in circumference. The deposits, in some parts, present a compact unbroken precipice of 200 feet in height. In other parts it is not more than 50 or 60 feet high; but in all cases, so hard has it become, that the sailors who obtain it are compelled to blast it with gunpowder in order to separate the masses. So inexhaustible do these deposits appear, that the abstraction of 300,000 tons produces no sensible diminution of them. It generally appears in layers of from 3 to 6 inches in depth.

Many of the deposits on the main land are covered with sands; and Humboldt mentions, what is still more extraordinary, that on the Mexican coast deposits have been discovered under rocks, mixed with the bones of seals and other marine animals, as well as the remains of sea-fowls. It is impossible for an European who has never visited those regions to form an adequate conception of the number of the birds by which these deposits are made. When on flight they darken the air for miles, darting down in countless myriads to catch the pilchards with which those seas are filled. Towards evening they make their way to the islands, or those spots of the mainland to which their inclination directs them.

It is estimated that when Peruvian guano sells for £10 per ton, the ammonia it contains costs the purchaser, on an average, 5*d.* per lb., or £2 6*s.* 8*d.* per cwt. Nesbit reckons the value of ammonia in the market at £3 per cwt. or about 6½*d.* per lb.; so that in purchasing the best Peruvian guano, the buyer effects a considerable saving in the most essential constituent of manure, besides having it in combination with other matters of almost equal value, or at least that are indispensable to the plants, and in a form the best adapted for developing its extraordinary powers. Guano should be kept perfectly dry, and as little exposed to the air as possible. Lime or ashes should only be mixed with it when about to be used on the land. It is either applied broadcast as a top dressing, or by being ploughed in; or it can be drilled in rows under the seed, but care must be taken that it does not, in its fresh state, come in contact with the seed, for so powerful is its nature that it will infallibly destroy the vegetative principle. The best way, therefore, is to either sow it broadcast, and plough it in some days before the seed is put into the ground, by which means the ammonia will have dispersed itself through the soil; or to apply it as a top dressing, in the case of wheat, in the spring, mixed, as we have stated, with salt, in order to check the exuberant growth of the straw, and prevent it from being lodged. For turnips it is best mixed with farm-yard manure. It is frequently applied with great effect with a green crop, whether of buck-wheat, or other kind, ploughed in as manure. In that case, 3 cwt. of guano will supply the more important elements of fertility, and the green manure furnishes that in which the guano is deficient. Morton states, that he has known 30 tons of carrots raised per acre on land thus treated, the green manure being dug in. The spade, in fact, is at all times the most efficient, and, in the result, the cheapest implement in the cultivation of the carrot, which requires a soil deeply pulverised, and to have the manure, whatever it may be, well mixed to the very depth of the tillage.

The number of substances that give value to Peruvian guano are very few, not more indeed than three, namely, the various forms of *ammonia*, as shown in the minute analysis; the *nitrogen*, which also eventually passes into ammonia; and the phosphate of lime and magnesia. All the other elements are of less value, and may be obtained at little cost; but it behoves the purchaser of guano, or any other special manure, to ascertain, by analysis, the quantity of these three ingredients contained in them before closing his bargain. The following is the scale of value of the different materials found in guano, and other manures, as given by the late Mr. Nesbit:—

	Multipliers of Value.
Nitrogen	£74 per ton.
Ammonia	60 ,,
Phosphate of lime	8 ,,
Phosphate of lime, made soluble	24 ,,
Organic matter	1 ,,
Alkaline salts	1 ,,
Sulphate of lime (gypsum)	1 ,,
Silica	no value.
Carbonate of lime	,,

In estimating the value of different manures according to the above scale, Mr. Nesbit has given the following rules.

"Consider the analysis as representing the components of 100 tons. Multiply the respective amounts of each ingredient by its price per ton in the preceding table; add up the several products, and the sum will represent the value of 100 tons. Divide this amount by 100, and the quotient will be the price per ton." The following examples, given in the same work, illustrate the principle:—

1. Valuation of an Average Sample of Peruvian Guano.*

		Value per ton.	Total.
Moisture	15·10		
Organic matter	51·27	× £1 =	51
Silica	2·20		
Phosphate of lime	22·13	× 8 =	176
Phosphoric acid	3·27		
Phosphate of lime (made soluble)	7·00	× 24 =	168
Alkaline salts, &c.	6·07	× 1 =	6
Nitrogen 13·54, equal to	100·00		
Ammonia	16·42	× 60 =	260
		100)	£13/61
			20
Value, £13 12*s*. per ton.		)	*s*. 12/20

* See Nesbit's "Lectures on Agricultural Chemistry," pp. 124—126.

3. VALUATION OF A GOOD SAMPLE OF SUPERPHOSPHATE OF LIME.

		Value per ton.	Total.
Moisture	19·82		
Organic matter	20·72	× £1	= £21
Silica	2·80		
Soluble phosphate	10·25		
Neutral phosphate (made soluble)	16·00	× 24	= 384
Insoluble phosphate	16·00	× 8	= 136
Hydrated sulphate of lime	29·81	× 1	= 30
	100·00		
Ammonia	2·00	× 60	= 120
		100)	£6/91
			20
Value, £6 18*s*. per ton.		) *s*.	18/20

5. VALUATION OF A SUBSTANCE LATELY INTRODUCED INTO COMMERCE, CALLED "MEXICAN GUANO."

		Value per ton.	Total.
Moisture	3·24		
Organic matter	13·56	× £1	= £14
Silica	0·60		
Phosphate of lime	25·60	× 8	= 208
Carbonate of lime	46·14		
Sulphate of lime	10·86	× 1	= 11
	100·00		
Nitrogen 0·21, equal to ammonia	0·26	× 60	= 15
		100)	£2/48
			20
Value £2 9*s*. per ton.		) *s*.	9/60

Special Manures, according to Stephens, are those compound manures which are specially adapted to certain plants. He therefore, very properly, does not include in this category either farm-yard manure, bones, or guano, all of which are equally applicable to every kind of crop in one form or degree, or another. Nor does Mr. Stephens include those manures that are avowedly concocted as substitutes for bone-dust and guano.* The term *special* or *specific manure* is applied solely to those compounds which are intended to promote the growth of certain plants for which they are peculiarly adapted by the similarity of their constituent parts. Liebig has obtained the credit of having first suggested the subject of special manures to the agricultural world. But here again, as in the case of superphosphate, this certainly great chemist takes credit as an inventor, when he is only a copyist. Mr. Grisenthwaite, a young chemist whom the writer had the pleasure of knowing, having met him at the annual sheep-shearings of T. W. Coke, Esq., at Holkham, published a small work on the subject, which the writer has now before him.† It was issued in 1818, and dedicated to Mr. Coke, under

* "Book of the Farm," 4905, vol. ii. p. 411.

† As an illustration of the correctness of Mr. Grisenthwaite's views on this subject the following simple anecdote was related to the writer by Grisenthwaite at the time it occurred, which was *twenty years before Liebig started as new* the theory of special manures. A lady was complaining to Mr. Grisenthwaite that she could not keep her plants alive, although she took infinite pains to do so. Mr. Grisenthwaite took a sample of the mould and of the plants; analysed them both; found in what the former was deficient, and gave it to the lady in a chemical form. After this she had no further reason to complain of the difficulty of keeping her plants alive.

the title of "A New Theory of Agriculture." Mr. Grisenthwaite was then living at Wells, or Lynn, in Norfolk, but afterwards removed to London, and eventually, we believe, to Nottingham. Whether he is still living the writer is not aware, but he feels pleasure in being able to bear testimony to his claim to a discovery and its practical application, which, after a lapse of twenty years, is ignored, and the invention claimed by one who needed not such an act of self-appropriation to increase his fame as a first-rate chemist and man of science.

Grisenthwaite issued a second edition of his work in 1830, in which the following passage occurs, which indelibly establishes his claim to the invention of the new system. "The subject of *specific manures* has never been regarded by practical men, nor even been considered by writers on the theory of agriculture, though some practices have been recommended, and some opinions formed, even from the earliest ages, which are only explicable upon the principles here laid down. And yet when viewed in its relation to the whole economy of agriculture, it forms, perhaps, one of the most important, as it is certainly one of the most interesting, objects connected with it. Upon the clear understanding of it depends the successful business of the farmer. It is calculated to raise the operations of the agriculturist to a level with those of the manufacturer; and instead of committing the cultivation of the soil to accident, as if nothing were understood respecting it more than the mechanical preparations of it for the seed, it will serve to explain upon what causes growth and production, and, consequently, their opposites—abortion and non-production—fundamentally depend; and, of course, will enable him to provide against both. Agriculture may be considered a system of operations designed to convert manure into certain vegetable matters; and the land, or soil, performs the office of an instrument in the process; that all the care bestowed on its preparation is only intended to render the conversion more certain and complete; that it accomplishes these desirable ends by facilitating the action of air, heat, light, &c., upon the substances committed to it, and by giving to water a freedom of motion through it. This view of the business of agriculture will open to us many objects which have hitherto escaped observation, and which have never excited attention or reflection; perhaps because the whole operation has been thought beyond the power of the human mind. What is done spontaneously, and without any co-operation of man, is called natural; what is done by his exertions is called artificial—as if the same laws did not govern the result in both; whereas man, under any circumstances, can only bring the laws of nature into action,—he cannot create new laws, nor modify those which already exist. But to distinguish between those which are in action without his care, and those which he calls into play by his own labour, has placed a great impediment in the paths of science, and stopped for a long time the career of discovery. It has repressed inquiry by pronouncing it to be vain, and exertion, by declaring its inefficiency."*

Such were the opinions and sentiments of a scientific man upwards of forty years ago; and although he lived evidently too soon for the intelligence of the time, and great advances in science have since been made by agriculturists, the record he has left may be read with profit in this more enlightened and scientific age, when, by the recommendation of a more fortunate, but not more skilful chemist, the principles he so clearly laid down are being reduced to practice. The merit of Grisenthwaite was

* "New Theory of Agriculture," p. 90.

so much the greater that he stood almost alone in his views, which nevertheless were based upon the most correct data, namely, a knowledge of the constituent parts of vegetables, and a comparison of them with those of the manures intended to be applied.

Thus, the grain of wheat is chiefly composed of starch and gluten. The specific manure, therefore, for this cereal should be replete with phosphoric acid and nitrogen; and cattle bones contain these elementary substances in a greater abundance than any other manure. In barley, the nitrate of soda and nitrate of potash (saltpetre) are essential elements. The proper manure, therefore, for this grain should contain a proportion of these materials if the soil is destitute of them, or holds an inadequate quantity. A few pounds per acre will be sufficient. For beans, Grisenthwaite recommends manure containing a portion of subcarbonate of potash; and for peas, the super-oxalate of lime, that material being a prominent constituent in the pea. For sainfoin, clover, lucerne, and other of the *trifolium* class of plants, sulphate of lime, or gypsum, has proved the best specific manure. This substance was at one period recommended to be applied to every description of crop, and many farmers were led astray by it, having, upon trial, found it do no good whatever to wheat or other grain. Even as a mechanical dressing, intended to improve the texture of the soil, it is inferior and far less durable than chalk or marl, on account of its solubility. But the trefoils require gypsum for healthy vegetation, and to assist in the assimilation of other materials peculiar to their own nature, or the development of their distinctive characters.*

The turnip and mangold require sulphuret of lime, which when brought into contact with water evolves sulphuretted hydrogen. If gypsum is mixed with common coal, and the compound be exposed to great heat, the sulphuric acid of the sulphate will be decomposed, and a sulphuret formed, which being ground to powder will prove a good top dressing for turnips.†

Next to the knowledge of the specific manure required for certain plants, is that of the quantity necessary to be applied. This is an important point, because that which may be necessary for that particular plant may not suit the crop which follows, and any excess therefore will, so far, be thrown away, or at least must remain in the soil dormant until the same crop comes round again in the course; the interest, therefore, at least of the money, is lost, as well as the use of it. "It ill accords with my notion of what farming in the present day ought to be," says Mr. Nesbit, "that a man should put a sufficient quantity of manure upon his land to last for nine or ten years, losing the interest of his money for the whole of that time. As well might he put £10,000 into a bank, and keep it there for ten years, simply because he might want to spend a thousand a-year, thereby losing some hundreds a-year of interest during the period. The introduction of artificial manures has inaugurated a new era in the art of farming. . . . I would impress upon you, that if you proceed on the old system, when you have the means of determining exactly how much manure you require, you are only wasting your capital and losing your interest. You can grow any crops you like, by attending to this matter. Is it not foolish to administer at once to the soil as much as would suffice for three, or four, or five crops, when the land is subject to all the vicissitudes of rainy seasons, when almost everything soluble must be washed out of it? Instead of a quarter, or a quarter and a half, of bones being necessary, as formerly, a few bushels,

* "New Theory of Agriculture," p. 116. † Ibid., p. 119.

acted on by a third of their weight of acid, and rendered soluble, will produce not only an equal, but a better crop, and some effect may even be seen in subsequent years."*

What is here shown in reference to bones, may be also applied with equal truth and propriety to other manures. Thus, if turnips are *taken* off the land instead of being *fed* off upon it, the barley will require a top dressing; and 84 lbs. of either guano or nitrate of soda, and 4 cwt. of common salt, will be abundantly sufficient.

There are now manufacturers of artificial manures who profess to sell specific compounds for each description of vegetable; and that this may be done is certain; but, at the same time, the manufacturer must either be a chemist himself, or he must employ a chemist who is well acquainted with the anatomy of the plants of the farm, and the nature of those chemical substances forming their constituent parts. Without such knowledge, the farmer will still be working, as it were, blindfold, and must apply his manure, both as to nature and quantity, quite at random.

Nor is such caution the vagary of a mere speculative man of science; although, even in that case, it would be worthy of every attention. How few of the practical men are acquainted with the nature of that on which they mainly depend for success—the farmyard manure. Still fewer are those who give themselves the trouble to preserve the most essential parts of that manure, which, in fact, are the most easily lost. A practical man,† writing on this subject, makes the following sensible observations:—"The natural sense of the most careless farmer will inform him, on putting his mixen together, and for some time afterwards, that some of the result of this operation is escaping into the atmosphere. If he would lend an ear to science, she would inform him that, under exposure to the air, decomposition of the manure takes place; that the consequence is, the liberation of the gas which has attracted his attention; and that this gas is the essential spirit and vital agent in the production of his green and cereal crops, departing from the body which he has been at the cost of collecting together and making. He has probably devoted much time to unavailing lamentation over *prices*—the unremunerating price of 40*s.* per quarter for his wheat. If he would bestow the same attention on contriving means for arresting and appropriating this volatile essence, he would probably find that he might thereby obtain its equivalent in quantity. If his farm, manured with the *caput mortuum* which he has been accustomed to use, has yielded him 24 bushels of wheat per acre, it is a very moderate assumption that, with skilfully-made and well-preserved manure, the same land would yield him 30 bushels. A simple calculation will demonstrate that he has thereby placed himself in the same position as if he had sold his 24 bushels at the hoped-for price of 50*s.* per quarter, to say nothing of the relatively increased value of the succeeding crops of his rotation."

Liquid Manure.—The question of the comparative value of liquid and solid manure, and of town sewage as a modification of the first, is at present occupying the attention not only of the agriculturists, but of the legislature itself; for such is the magnitude to which the sewage of the metropolis and other of our large cities, and the question of its economic and sanitary disposal, have arisen, that it has been deemed advisable to appoint a Committee of the House of Commons to inquire into the value of the sewage, and the possibility of disposing of it in such a form and manner as to render it available for the purposes of agriculture, at an expense that will induce the occupiers of land to avail themselves of it. The report of the commissioners has been delivered in; and we

* "Agricultural Chemistry," p. 29.

† Mr. Lawrence, of Cirencester.

shall have occasion to refer to it, after describing the mode of preparing and using the liquid manure made on the farm.

The best known and most strenuous advocate of the use of liquid manure is Mr. Alderman Mechi, of Tiptree Hall Farm, near Colchester, whose unsparing expenditure of money in experimental farming, while it has drawn down upon him the ill-will of ignorance and prejudice, has, in a few years, converted a barren and intractable heath into a fertile and productive farm, producing every kind of crop in an abundance that amply repays him for the outlay. Believing, as we do, in that gentleman's perfect sincerity and veracity, as well as in the correctness of his views regarding the value both of the farm liquid manure and the town sewage, we cannot do better than take the description of his plan of managing the first for our model, and shall therefore, without scruple, copy from his own account of it.

Mr. Mechi feeds his cattle on the *stabulation* principle, and the floors of the cattle sheds are so constructed that the liquid and solid droppings from the animals pass through the interstices of the boards into a cellar or cave underneath. This cellar is connected with a tank outside by a 2-inch pipe on one side, and with a supply of water on the other, which, by a powerful jet, washes the manure from the cellar into the tank. This operation is repeated twice a week, when the place is completely cleaned out.

The tank itself is 30 feet deep, and the same in diameter at its widest part, and it is connected with other smaller ones which discharge their contents, collected from other departments of the homestead, into it. A *bog-spring* capable of supplying 30,000 gallons of water per day communicates with the main tank, and pours into it enough water to fill it to the depth of 12 feet. Two pumps of 20-inch stroke and 5½-inch bore, each capable of raising and discharging, at ordinary speed, 80 gallons per minute, are connected with the tank.

The liquid manure being prepared in the tank, is raised by the pumps, and poured into pipes, by means of main pipes. The pipes are of 3-inch diameter, of cast-iron, and are laid in at the depth of 18 inches all over the farm, at a regular distance from each other. A *hydrant*, or iron post-pipe, is placed in connection with the conveying pipes to every 11 acres, and gutta-percha hose from these convey the liquid manure to every part of the farm. These hose are 200 yards in length; and half of it is 2 inches, and half 1½ inch, diameter. One man, and a boy or lad to assist him, distributes 600 hogsheads per day, and the pumps are so constructed as to supply either liquid manure or plain water, as may be required.

The expense of thus furnishing the apparatus for 170 acres, Mr. Mechi estimates at £600, or about £3 10*s*. 7*d*. per acre; but we think it advisable not to take it at less than £4 or £4 5*s*. per acre, to allow for casualties. This expense covers tanks, pumps, iron pipes, gutta-percha hose, and every other expense, except the steam-engine by which the whole is worked, and of which only three-horse power is required. An abundant supply of water is absolutely necessary to carry this system out to perfection. The cost of one day's application of the liquid manure on 10 acres Mr. Mechi gives as follows :—

	s.	*d.*
Interest on capital at 7½ per cent.	6	0
My engineer's pay for one day (a youth from the farm)	1	6
One man in the field, 1*s*. 6*d*.; one youth do., 1*s*.	2	6
Coals for engine (this is, in fact, 1*s*. more than the cost, as we use screenings at 9*s*. per ton)	3	0
	13	0

"Thus, 1*s*. 6*d*. per acre will more than cover the cost of distributing 150 tons of manure or water on 10 acres of land; and even if it costs more, under less favourable circumstances than mine, the expense is ridiculously small in comparison with the ordinary cost and waste."*

Liquid manure is especially useful on light soils. In Belgium and Holland, as we have seen, it has been the sole means of rendering large tracts of such land fertile. In those countries every kind of organic matter is brought into requisition, and amalgamated with farm-yard manure and night-soil to make up a compound in their tanks. The cheapness of labour, and the smallness of the farms, in the management of which the women and children take a share, render this mode of manufacturing manure much cheaper than it would be in England, where every species of labour has to be paid for in hard cash. Notwithstanding this, there is no doubt that the English farmer could, if he were disposed, find means of preparing and applying it in an economical manner. Mr. Mechi has, at a great expense, both shown the way how to do this, and illustrated its advantages on a broad scale. Others may safely adopt the system at much less expenditure of money. Of the utility of liquid manure as a fertiliser, no one can have any doubt who knows anything of the agriculture of the Low Countries, where the poorest sands have been made to produce the finest crops both of roots, grain, and clover.

Town Sewage.—It has long been a subject of perplexity that so large a portion of the produce of the soil raised for the subsistence of man should be consumed without affording any compensation to it for its abstraction. An overwhelming portion of the cereal produce, and of the animals fed on the green and root crops, are consumed without any adequate return to the soil, by way of restoring the elements of fertility of which it has been deprived in their production. For many years this question has occupied the attention both of scientific and practical men—agriculturists, chemists, mechanicians, and others; but such is the contrariety of opinion respecting the value, and the means of rendering available the sewage of our towns, that hitherto, with the exception of a few instances, nothing has been done to solve the question, or to clear it of the ambiguity under which it seems to lie. In the metropolis, indeed, the subject has been allowed to remain in abeyance so long that its magnitude has reached such a point as to render it truly formidable to grapple with; and in pure despair of arriving at any satisfactory conclusion as to the disposal of the sewage in an economic way, it is about to be conveyed away to the Essex marshes, and consigned to the Thames, some ten or twelve miles below the city, in the hopes that it will be thus wholly and for ever disposed of as a nuisance to the inhabitants; and thus the *excreta* of three millions of people, of the estimated value of one pound per head per annum, is lost to the country and to agriculture.

Notwithstanding the proceedings of the Metropolitan Board of Works thus summarily to dispose of the sewage of London, many of the farmers on the line of the projected canal, for the conveyance of it to the Thames, are desirous of obtaining a portion of it in its transit, in order to distribute it over their grass and other lands; and the question now to be determined is, whether it is to be granted to them free, or whether a rent is to be charged upon the land for the permission to use it. The circumstance, however, of the application on the part of the farmers proves that they have at length become aware of its value, and that, provided it can be rendered available at

* "How to Farm Profitably," p. 87.

a small expense, it cannot fail of being beneficial. This is an advance in the right direction, because when once convinced of its value, there is no doubt but that the means will be found to render it available.

As in the case of liquid manure, so on the question of the application of town sewage, Alderman Mechi has been the first and the most constant advocate for its use; and on several occasions he has brought the subject before the members of the Central Farmers' Club at their monthly meetings, as well as other public bodies. The last occasion of the kind was on the evening of the first Monday in March, 1863, after the report of the Sewage Commission of the House of Commons had been published. As this report goes fully into the question of the value of the sewage, we shall abstract from it such portions as we consider necessary to put the reader in possession of the main points of the subject.

It is estimated that, taking the population of the United Kingdom in round numbers at thirty millions, and the value of consumable articles of food at £9 per head per annum, we obtain the amount of £270,000,000 sterling as the consumption of the whole country. The value of the *excreta* from it is estimated at 10 per cent., which again gives a value of £27,000,000 sterling. In most country places in which the water-closet has not yet been introduced, the *excreta* is disposed of to the neighbouring farmers, and, without having any data to go upon, we may estimate that one-third is thus economised. But it is in the towns that we must look for the great body of *excreta*, and of these not more than ten or twelve, containing populations amounting probably to not more than four or five hundred thousand persons, have adopted the plan. We shall now give the results at the principal of these places, as stated in evidence before the Committee of the House of Commons, in 1862:—

At Croydon, in Surrey, the sewage has been used for some time, and Mr. Fenton gave evidence of its utility. But the most conclusive testimony was that of Mr. Marriage, of Chelmsford, who has recently taken the farm of 300 acres on which a part of the sewage of the town of Croydon is expended. For this farm he pays £1,500 a year rent; and as the land lies on a gentle descent from the town, no power is required to distribute the sewage, of which he obtains the *liquid excreta* of about 18,000 persons, the *solid* matter being arrested by filtration. The sewage, too, is mixed with a million gallons of water daily, and this, it appears, is doubled by the rain-fall and springs. Yet so beneficial is it to the land, that the first summer (of 1861) he took the farm, the grass was so stout that he had to pay 10*s*. per acre for mowing; although "in May you might have seen a lark running on the ground, so bare was it." Mr. Marriage has laid down the whole farm in grass, of which he intends to sell the produce to the London cowkeepers. In direct contradiction to Professor Voelcker, he stated that he found his cattle gained flesh as fast again on the grass at Croydon as they did at Chelmsford; and the milch cows, also, of which he stalled fifty, produced a large quantity of milk, and at the same time gained flesh and kept healthy. He added that he "certainly considered sewage water to be very valuable for grass lands under favourable circumstances."

The next case we shall take is that of Edinburgh. The principal witness was S. C. Miller, Esq., late M.P., the proprietor of the Craigentinny meadows, near Edinburgh. The quantity of land operated upon is 250 acres, 200 of which are irrigated by gravitation, and the remaining 50 acres by hydraulic pressure. The sewage is conducted by main carriers and open gutters, and flows constantly night and day, except in winter, when, during the night, it is allowed to run into the sea. There is every variety of soil on the farm, from a sand (40 acres) to a strong clay (also 40 acres), and some very fine medium soil. The sewage, Mr. Miller states, is good for all soils, but the sand, of course, filters it the most effectually, discharging the water *clear* into the ditches. The grass is first cut between the last day of March and the 1st of May, and the crops are let by auction every year from the 1st April to the 10th of October. The sewage is applied twelve times a year. The average letting is £22 per imperial acre for the six and a half months. The Edinburgh cowkeepers are generally the purchasers of the produce, having to fetch it six miles. The greatest produce is received in hot weather. "It is marvellous to see the grass in hot weather when it has been cut in the morning, and the roots are quite white from a heavy crop; they will be green in two days." The best time for applying the sewage is immediately after the grass has been cut. He says again, "The sewage is a marvellous application of manure, not only in this, but in various other cases, and we shall all come to it, more or less, in the course of time, and when better understood, I am quite satisfied." The slope of the land is 1 in 100. The crops vary with the season, independent of the sewage. Hot, dry summers are most advantageous. The rent, however, is fully maintained. "The sandy land produces more than the clay land, but less than the rich, friable land." In proceeding from the town, the sewage becomes mixed with the water of several small brooks and streams, in the same way as the sewage of the town of Mansfield is conveyed by a small stream into which it was made to flow to the Clipstone Park meadows, belonging to the Duke of Portland. Mr. Miller's testimony was confirmed by that of Mr. Hope, a neighbour, who stated that the "sandy land next the sea is worth, in its natural state, 5*s.* per acre. I suppose it would now let at £30 per acre to a cowkeeper. When the sewage passes from the sandy land to the sea it is quite pure. You could not tell that it had been dirty water at all. Cowkeepers prefer the sewage grass to the ordinary young unirrigated grass." Mr. J. C. Morton spoke of the effect of the sewage on the Lochend meadows, Edinburgh. They were laid down with Italian rye grass, and irrigated by pumps, pipes, hose, and jets, receiving from 600 to 800 tons at each cutting. The produce realised from £21 to £27 10*s.* per acre, the soil being a very light one. What is most remarkable in this case is, that although Edinburgh lies 7° further north than Croydon, the grass is a fortnight earlier there than at the latter place, which Mr. Morton ascribes to the greater quantity of sewage applied to it.

At Birmingham the sewage amounts to about 12,000,000 gallons daily, but water-closets are only very partially adopted in the town, and the greater portion of the *excreta* is received in cesspools and ash-pits. Sixty tons per day of solid matter is also intercepted from the sewage, and *given away* to the farmers after being partially dried, and it is fetched eight or ten miles. The liquid sewage flows over 60 acres of land, which yields enormous crops of grass, and it is grazed very late, the hay being also much earlier upon it than on the neighbouring lands. The sewage flows into the river Tame, and some of the farmers have already conveyed it thus diluted over their meadows, at an expense ranging from £9 10*s.* to £15 per acre; and it was stated by Mr. Tell, the borough surveyor, who gave evidence before the committee, that others in the vicinity of the river were anxious to avail themselves of it. It is considered that the sewage irrigation, without other manure, was quite equal to that of water on manured meadows. It was also stated that it cost the town of Birmingham £6,000 per annum to get rid of the cesspool sewage, night soil, &c.

From Rugby there was the evidence of Mr. J. C. Morton and Mr. Lawes. The first spoke of a crop of Italian rye grass, which, after nearly maintaining forty-five cows for four weeks, had then a crop of 9 tons per acre upon it. The sewage was pumped up by an engine of sixteen horse-power, and conveyed by pipes over the surface. Mr. Lawes, in contrasting the effect of dry manure with sewage, stated, that the largest produce he ever obtained from an enormous quantity of dry manure was about 12 tons per acre of green produce, whilst from sewage the produce was 32 tons. "Twelve pounds is a large rent for a very good water-irrigated meadow; if you put on sewage, you would probably get from £30 up to £40 per acre. I could get from £30 to £40 rent per acre for the 15 acres at Rugby, if I put on sewage enough; but if water irrigated, £6 to £7 per acre—that is, if the sewaged meadows had received 20,000 tons of sewage per acre. I suspect that amount is put upon some of the Edinburgh land." The unsewaged land kept a cow for twenty weeks; the next acre, receiving 1,500 tons of sewage, kept a cow forty weeks; the next acre, 3,000 tons, kept a cow fifty-eight weeks; the next acre, which received 4,600 tons, kept a cow sixty-six weeks. The milk was valued at 8*d.* per gallon, and produced—

Unsewaged acre	£11	3
1,500 tons sewage do.	18	14
3,000 tons sewage do.	26	18
4,600 tons sewage do.	31	11

These careful experiments establish, beyond a doubt, that the quantity of grass increases as the quantity of sewage is increased, and that the application of sewage produces much earlier and much later feed. These experiments were made at the instigation of the Sewage of Towns Government Commission of Inquiry of 1862. The Commission paid £5 per acre rent, and one penny per ton for the sewage; but Mr. Lawes considers that it might be conveyed to the land at about one farthing per ton. The experiments were conducted for two years, and over an area of 15 acres. The sewage was all measured, the grass weighed, and strict tabular accounts kept of every detail, the manure analysed, &c. The five-acre field produced 33 tons of grass per acre. The ten-acre field produced 27 tons. With an enormous quantity of ordinary or dry manure, no more than 12 tons could be obtained.

At Watford, in Hertfordshire, the sewage of the 4,000 inhabitants is taken by the Earl of Essex, who gave evidence before the Committee. He stated that he had applied it with great advantage (barring engineering mistakes) to almost every kind of crop. When his mangold failed, he transplanted a field of them at the middle or end of June, and saturated it with fresh sewage. He had the finest crop ever seen in that neighbourhood —say, 47 tons per acre; applies 600 tons to ordinary grass, and gets enormous crops; and puts 5,000 tons per acre per annum on Italian rye-grass. It would pay well at a halfpenny or three farthings per ton, and he uses 60,000 tons a year. It has a permanent influence on the soil: 600 tons per acre has destroyed fern and a quantity of plantain and coarse weeds of that kind, which have been replaced by valuable grasses.

Similar testimony to the value of town sewage was given by persons from Coventry, Carlisle, Malvern, Chatham, and other places, proving what, in fact, common sense alone, with the slightest knowledge of the nature and effect of manure, might convince, that water charged with a portion of organic matter must be more beneficial to the land than without it; and that the benefit will be derived in proportion to the quantity administered. It is not wished, on the other hand, to conceal the fact that there are persons of weight in the scientific world who are opposed to the use of sewage, and of these is Professor Voelcker, who considers it too great a nuisance to be tolerated on the land. At the meeting of the Farmers' Club, in the discussion which followed Alderman Mechi's lecture, he spoke strongly against its use, and endeavoured to show that grass from sewaged land containing more nitrogen than other grass was less nutritive, and that animals fattened upon it gained flesh more slowly than on unmanured grass. This opinion, which was entirely theoretic, and founded on analysis, was flatly contradicted by the practical remarks of Mr. Marriage, which we have already referred to, and than which nothing could be more satisfactory and conclusive.

It is probable that before this work goes to press, the gigantic preparations for conveying the sewage of the metropolis to the Essex marshes, and thence into the Thames, will have been finished, and that hydraulic apparatus will be erected on the whole line of the canal for conveying the sewage over the adjacent meadows and fields. The light thrown on the subject by the evidence given before the Committee of the Commons cannot fail of having its effect on the minds of those who occupy lands conveniently situated to receive it. Mr. Lawes' practical experiments, and Mr. Marriage's business-like narration at the meeting of the Club, are conclusive on two points—that sewage grass is more valuable for milch cows than other grass, and that "bullocks fed upon it fattened twice as fast as on common grass." We shall close by giving Alderman Mechi's concluding speech:—He "was very glad to have had a confirmation of the evidence in the remarks of Mr. Marriage, who could show the largest instance of sewage irrigation within about 100 miles of London. If the grass produced near Croydon were of such fattening quality, it might be inferred that elsewhere the result would, under similar circumstances, be equally satisfactory. He quite agreed with those who said that the question turned on the cost of putting sewage water on land; but he could not agree with Professor Voelcker or any other man who said that by mixing sewage with a certain quantity of rain or other water, it lost its qualities, and became useless."

Tillage a Substitute for Manure.—A rather remarkable work, written by Mr. Alexander Burnett, land agent, was published a few years since (1859), in which the subject of tillage *versus* manure is treated in a masterly manner; and as it involves principles of considerable importance to the husbandman, we propose to offer some observations on the arguments brought forward in the work referred to.

We have already given an account of the Lois Weedon husbandry, which is a revival of the system and practice of the celebrated Tull at the beginning of the last century. For many years (fifteen) Mr. Smith has grown wheat on the same land without any manure whatever; and so far from having exhausted the land by this practice, it appears from his account that the produce of the average of seasons has rather increased than diminished, subject only to the vicissitudes to which the wheat-plant is liable under all or any circumstances. It is on the successful result of the Tullian and Lois Weedon system of husbandry that Mr. Burnett chiefly bases his theory of tillage *v.* manure.

It is well known that the ancient tillage of a farm was confined to the production of cereals, there being neither green nor root crops to provide for. To rectify the exhaustion which a succession of white crops must necessarily occasion, the land was subjected every third or fourth year to the bare fallow, and if very much exhausted, it was allowed to lie fallow a longer period. The fallow was absolutely necessary both to allow for the renovation of fertility and for the destruction of weeds, which, in the production of two or more successive corn crops, were certain to accumulate from year to year. Although during the cycle of three or four years each succeeding crop decreased in a compound ratio, it does not appear that the system itself was of an exhaustive character; for, according to the ratio of progressive production, it would appear that the acreable produce of the soil increased in amount. The following table, given in Mr. Burnett's work, illustrates this:—

Estimated Acreable Corn Produce of England at Various Periods.

	Wheat. Bushels.	Barley. Bushels.	Oats. Bushels.
1. In the thirteenth century	12	24	24
2. Latter part of the sixteenth	16 to 20	36	32 to 40
3. Third quarter of the eighteenth, at which period the old corn husbandry prevailed	23 to 24	32	36
4. Middle of the nineteenth	$26\frac{2}{3}$	38	44

Thus, under the ancient system of husbandry, with the help of such improvements as it admitted of, not only was the fertility of the soil maintained, but it was increased. Yet but little manure was applied to the tillage lands, the bulk of what was made being given to the pasture land to ensure a good crop of hay, which, in the absence of root crops, was of the first importance to keep alive the cattle and sheep during the winter months. The ploughed fields received only the surplusage, with a questionable addition procured by laying dry straw in the lanes, to be trodden by the horses and other animals of the farm into manure, and thence carted to the tilled lands. It was from observing the effect of this system of husbandry that Tull came to the conclusion that the fallow was the real fertiliser, and his convictions were reduced to certainty when he examined the process practised by the vine-dressers of France and Italy, who, by merely comminuting the soil, and keeping it perfectly clean, secured a perpetual fertility and productiveness without the help of manure, and even without a fallow, except in the intervals between the rows of vines, which, being constantly kept open by the hoe, supplied the roots of the vines with the necessary sustenance. His observation of this subject led to his invention of the horse-hoe, as well as the consecutive production of wheat on the same land for any number of years, submitting the land to an alternate annual fallow by planting only the half of it with strips, as we have elsewhere described.

Mr. Burnett considers that Tull entertained the correct idea of the twofold function of stercoraceous manure, namely, its *contributive* and its stimulative action; that it imparted fertilising elements *per se*, and that it eliminated them from the soil and the atmosphere to form the pabulum of plants; and to give full scope to these separate functions, thorough tillage was a necessary concomitant. By degrees he came to the conclusion that *much* tillage and *little* manure was far better for the land than *much* manure and *little* tillage; and ultimately he became convinced that tillage, if carried out to its fullest extent, might be entirely substituted for manure. "I have made," says he, "many trials of fine dung on the rows, and, notwithstanding the benefit of it, I have for these several years past left it off, finding that a little more hoeing will supply it at a much less expense than that of so small a quantity of manure, and the hands necessary to lay it on, and of the carriage." "The almost only use of all manure is the same as of tillage, viz., the pulverisation it makes by fermentation, as tillage does by attrition or contusion; and, with these differences, that dung, which is the most common manure, is apt to increase weeds, as (whilst) tillage (of which hoeing is the chief) destroys them; and manure is scanty in most places, but tillage may be had everywhere."

On this subject Professor Way has the following remarks, as quoted by Mr. Burnett:—"Now, although it has been a constant axiom in the instructions of chemists to farmers to return to the soil what the crops remove (and every candid agricultural chemist will own that at the outset of his career he has somewhat overrated the importance of literally fulfilling this obligation), it is certain that most soils of fair quality contain an amount of the different mineral substances far greater than is necessary for many succeeding crops of the most impoverishing character. . . . . The fact is, there is an almost unlimited supply of the mineral requisites of plants in soils, but that the great agricultural problem is to get at them—to render them available; and here, again, it seems reasonable to suppose that abundant cultivation, which lets in carbonic acid and ammonia to the soil, may, by that very act, be providing the potash and phosphate of lime which the carbonic acid, and the silica which ammonia, are endowed with the power of dissolving, and presenting to the roots of plants." It is not a little remarkable that chemistry, which was in its infancy during Tull's time, more and more confirms the great principle of which he was the discoverer, and only imparts to it the scientific form and feature which the imperfection of knowledge of the period alone incapacitated him from giving.

The following illustrative experiment for ascertaining the chemico-absorptive power of soils was made by the discoverer of the principle:—"He took some vegetable mould, and placed it in a filtering apparatus: he then poured on it a quantity of water, holding in solution a salt of ammonia, and when enough had passed through by percolation into a receiving vessel below, the filtered liquid was next tested for ammonia; none, however, was found; and hence it became certain that, in the descent of the water, the ammoniacal base had been abstracted from it, and appropriated by the soil." What the precise substance was with which the ammonia became combined has not been clearly discovered; but as the atmosphere contains a small proportion of ammonia, which descends to the earth in the rain, snow, and dew, this discovery of Mr. Thomas points out the manner of its retention in the soil for the benefit of the plants, of the food of which it forms an indispensable portion and element.

Liebig also confirms the same important fact of the chemico-absorptive power of the soil. "The soil," he says, "not only retains firmly all the food of plants which is actually in it, but its power to preserve all that may be useful to them extends much farther. If rain or other water, holding in solution ammonia, potash, phosphoric, and silicic acid, be brought in contact with the soil, these substances disappear almost immediately from the solution. The soil withdraws them from the water. Only such substances are *completely* withdrawn by the soil as are *indispensable* articles of food for plants; all others remain wholly, or in part, in solution."*

An important inferential principle is drawn from these facts which has hitherto been denied, namely, that plants do not receive their food from the soil in—or alone in—a liquid form, because it is plain that as soon as it enters the soil in that form it is separated from it, and unites chemically with the soil. It has not yet been clearly discovered in what way the roots of plants receive their food, but it is supposed that they appro-

* "Modern Agriculture," p. 30.

priate it by immediate contact with portions of the soil which contain it. This was also Tull's idea—"The mouths or lacteals being situate and opening in the convex superficies of roots, they take their pabulum, being fine particles of earth, from the superficies of the pores, or cavities wherein the roots are included. Fibrous roots can take in no nourishment from any cavity, unless they come in contact with, and press against, all the superficies of that cavity which includes them; for it dispenses the food to their lacteals by such pressure only."

We have ventured to give the preceding quotations relative to the Tullian system of husbandry, at the risk of being charged with repeating what has been said in a former part of this work. But the question is of so much importance that it cannot be too much or too often referred to in a treatise of this kind. The deductions Mr. Burnett draws from the premises are, first, that although the fertilising constituents of the atmosphere may, by adequate tillage, be procured in more or less abundance in any soil, yet, it is necessary that, for that purpose, *re-agents* must exist in the staple with which they may combine. And hence the unavoidable necessity arises, that to soils destitute or deficient of these re-agents, their presence there must be acquired by the placing therein, artificially, of the absent constituents, or, in other words, *by the judicious exercise of special manuring*; and thus again we find the axiom, "Tillage a substitute for manure," must be content to suffer greater or less relaxation in practice.

"Secondly, experimental instances there certainly are where Tullian husbandry has failed of success. In such cases the reasonable presumption is, that they were cases of soils deficient in the fixing re-agents; and if so, then, not to use adventitious substitutes would be no less a violation of Tullian principles than wastefully to apply them to soils whose tillage alone would more profitably be adequate.

"Thirdly, we conclude this branch by remarking that, step by step, as we approach more nearly the culminating point of Tull's teaching, we shall find still increasing grounds for regarding them as emanations from 'a deeply observant and philosophical mind' (Way), and 'as based on the soundest principles of natural knowledge.'"*

Some further important conclusions are deduced from the success of the Tullian system, of which the following is the principle, as stated by Mr. Burnett in his summary. That the ancient husbandry, which proceeded on the practice of a succession of corn crops, with only the intervention of a bare fallow periodically, was only vitiated by the inadequacy of the implements of tillage, either to cleanse the soil, or to admit the mechanical and chemical amelioration of the soil by the admission of the atmospheric phenomena. That successive corn growing, even under the imperfect system of tillage which was then practised, was so far from impoverishing the soil, that it actually increased in fertility and productiveness, as is proved by the table we have already given, and by the statements of historians who at different periods have written on the subject; and *that*, notwithstanding the very small quantity of manure which was applied to the arable land;—such, in fact, was the case with the land occupied by Tull himself, which, without *any* manure whatever, continued, year after year, to increase in the abundance of its produce. Subsequent experiments, when carried out fairly and fully on the Tullian principles, have also been successful, and have proved the truth and practicability, as well as the profitableness of the system.†

Whilst, however, there has been, to a certain extent, a general approximation to the

* "Tillage and Manuring," p. 65. † Ibid., p. 207.

Tullian system by the adoption of the corn-drill, horse-hoe, and a reduction in the quantity of seed sown, none of the modern agriculturists have, on an extended scale, carried out that system as Tull did himself. At the same time there appears to be a growing opinion that the present forms of alternate husbandry are, as Mr. Burnett expresses it, pregnant with danger, and it becomes a question whether Tull's cereal system may not advantageously be grafted on modern agriculture with advantage both to the landlord and tenant. The reiterated and general failure of the turnip and clover crops, and, to a certain extent, that of the mangold-wurzel,* have alarmed the farmers, and led them to think seriously of instituting some important change in their system of husbandry. What that change will be is still an unsolved problem; but that it will eventually approximate still nearer to the Tullian system than it ever has done at present, is the opinion of both Mr. Burnett and many others. We might instance, as the nearest approximation to it, the practice of the Marquis of Tweeddale, the inventor of the Scottish plough which bears his name, and who, by deep tillage and a thorough comminution of the soil, has, to a great extent, dispensed with the use of manure—certainly of an artificial kind—and yet has doubled his produce.

How far a greater and more extended adoption of Tull's practice will interfere with the cultivation of root crops and artificial grasses is another consideration, and one that, in the present and prospective state of the meat-market, is likely to prove the greatest obstacle. While the importation of cereals is safe and easy, even from the most distant countries, that of cattle is attended with great danger and difficulty, and, from the nature of it, is necessarily limited to the nearest continental countries, so that no extension of the number of animals can ever take place sufficient to overstock the market, or even reduce permanently the price of meat. Thus, with an increasing population, requiring larger accessions of food of all kinds annually, we shall have no difficulty in obtaining the needed supply of bread corn; but are almost exclusively dependent upon the home production for a supply of meat. Before, therefore, any change takes place in the economy of the farm, its bearing upon the breeding and feeding of cattle must be taken into consideration.

It is utterly impossible that we should fall back upon the ancient husbandry, which simply comprised the production of cereal and natural grass crops. At the period when that system prevailed, the population of the United Kingdom was little more than one-third of its present amount; and the number of animals reared on the pastures, and fattened on hay and corn, was amply sufficient for the consumption. A population of thirty millions instead of ten makes a wide difference, especially when the lower classes eat much more animal food than formerly, because they earn more money. Even with the present enormous production of fat animals, the price of meat is annually increasing; and any serious interruption to, or decrease in, the supply, would raise the price to a degree that would constitute a prohibition of its use to the largest present class of consumers.

Without any material interference with the present system of husbandry, we may look to a more elaborate system of tillage to solve this problem; nor is this a difficult thing to accomplish, with the enormous increase of aratory power acquired by the application of steam in the cultivation of the soil. It is now an established fact that deep culture,

* In many counties of England this failure has been so general and repeated, that the farmers have decided to abandon the mangold cultivation.

perfect comminution, and thorough draining, are certain means of increasing the produce, and of preventing, so far as human means can do so, those failures to which the root crops have latterly been subject. Let the manure of the homestead be all applied to these, for which it is best adapted; and let the wheat crop especially be left to find its means of fertility—its food—from the atmosphere, poured into the pulverised soil by the snow, the rain, the dew, alternating with the air itself in the possession or occupation of those interstices which the improved tillage has created in the soil and subsoil. Let the former be kept open by the horse-hoe, which will greatly promote the vegetation. The Tullian system, too, may safely be adopted on this plan much more profitably than by Tull himself, because we possess the means of stirring and opening both soil and subsoil to a much greater depth than he could possibly effect with his imperfect implements of husbandry. The Lois Weedon practice has demonstrated the certainty that Tull's system can be carried out *à l'outrance*, not only without deterioration to the land, but with an increasing productiveness.

The experience of the last year (1862) may well alarm the agriculturists, and cause them to seek for means of meeting the competition to which they are now exposed. Eighteen and a half million quarters of imported cereals, of which eleven and a half million quarters were wheat and flour, if repeated many, or even a few seasons, would completely swamp the native agriculture, unless means are devised to stem the torrent, by increasing the produce of the land and lessening the expenses, so as to be able to undersell the foreigner. We believe that this may be done; and that if the land was cultivated to the best advantage, the British farmer would be in a position to export as he formerly did, instead of importing to an extent that is annually reducing the price below the present cost of production.

SECTION IX.

THE DAIRY.

The high price to which every kind of animal produce has risen in the United Kingdom has made it a question of interest to the farmer whether, with an equally low price of cereal produce, a large portion of the land now under the plough for raising corn would not be more profitably employed in grazing, either for the butcher or for the production of milk, butter, and cheese. On the one hand the certain prospect of a constant supply of bread corn, limited only by the price at the place of consumption, affords no hope that, on the occurrence of a deficient harvest, an adequate price can in future be depended on; and, on the other, the importation of cattle, whether fat or lean, is attended with so much danger and expense, that not only is it limited to a very few of the nearest continental ports, but even at those the numbers shipped to England are comparatively very small, and cannot by any possibility be much increased. It is certainly otherwise with the produce of the dairy, the importations of which have increased greatly the last four years, previous to which they had rather fallen off, as the following returns of the Board of Trade will show:—

IMPORTATIONS OF CHEESE AND BUTTER FROM 1856 TO 1862 INCLUSIVE.

	1856.	1857.	1858.	1859.	1860.	1861.	1862.
Cheese, cwts. . .	406,323	393,323	364,087	406,547	583,283	706,395	703,909
Butter, „ . .	513,392	441,606	387,565	425,663	840,112	992,772	1,037,371

Notwithstanding this large importation, which in 1862 amounted to nearly $7\frac{3}{4}$ lbs. of butter, and $5\frac{1}{2}$ lbs. of cheese, per head, of the whole population, there is no sensible diminution in the price of either, the demand keeping pace to the fullest extent with the supply. It would therefore appear that there is ample room for the establishment of more dairy farms, especially when we consider that the population continues to increase, at least in England, where the consumption of animal food of all descriptions is by far the largest individually.

It is true that so far as the natural capabilities of this country are concerned, the number of dairy farms is regulated by the low-lying meadows and pastures; and that in those parts of it where these advantages are enjoyed the land is already so occupied. Thus, in Cheshire, Gloucestershire, and Suffolk, *specially*, and the lands bordering the rivers throughout the kingdom *generally*, large herds of milch cows are kept, by which the population receive their supplies of dairy produce. But in these days of high farming, artificial pastures, irrigation, and, above all, the stabulation or stall feeding of cows, as well as of other cattle, the dairy farms need not be confined to the natural advantages of the country. Dairies already exist in towns, the cattle of which never see a green field; and we have in view others in the country in which the cows are tied up all the year round, and their food brought to them; and this is considered by far the most economical method of feeding them, and is by no means injurious to the health of the animals or to the quality or production of milk. Nor is this system entirely new, for it was practised at the beginning of the present century with great success by Mr. Curwen in Cumberland, by Mr. W. Harley, of Willowbank Dairy, near Glasgow, and others. The latter gentleman, who kept on an average 260 cows, and supplied the town of Glasgow with pure milk, published an account of his dairy system in 1829 (the title of the book being "The Harleian Dairy System"), and both he and Mr. Curwen agree in bearing testimony to the utility of house-feeding, the quantity of milk obtained being much greater than when the cattle are allowed to roam in the fields, and the quality much richer. Mr. Curwen also published an account of his system in 1808, the title of the tract being, "On the Means of supplying Milk to the Poor." We shall refer to both these works again presently.

The first thing to engage our attention relating to a dairy farm is the dairy itself, and the following description of what such a building should be on a farm where utility and economy are the objects of the occupier, is taken from a work published a few years since.

"On farms where only a small number of cows are kept, the dairy is generally a small apartment in the farm-house; but on large dairy farms it is a separately-constructed building, and should contain three separate apartments below, with cheese-rooms above.

"The dairy-house should be placed, if possible, on a porous soil, and sheltered from north and east winds. The principal apartment is the milk-room; the floor of this should be sunk three or four feet below the surface of the ground, and be paved with marble, polished stone, or tiles, and slope towards a drain from which the water must run freely away—stagnant water, and smells of all kinds, being exceedingly injurious. Indeed, so delicately susceptible of injury is milk, that the smell from cheese, rennet, cooked or uncooked meat, will often cause considerable injury.

"About three feet from the floor should be placed, on three sides, shelves two feet broad, of polished marble or brick, on which are placed the pans to contain the milk. The best material for dairy shelves is Galway marble, as it is the least absorbent. If the shelves are made of wood, it should be beech or plane-tree, these woods being the hardest and most stainless. The ceilings and walls should be plastered. The windows should be covered with fly-gauze, and be fitted with Venetian blinds, and shutters outside. A lock-up cupboard should be conveniently placed, and the door covered with perforated wire-gauze.

"*The Churning-room.*—In this apartment is placed the machinery for converting the milk into butter. This is worked in various ways; when large, the motive power of the homestead is employed in driving it, by connecting it by a lay-shaft, or by bands. When the dairy-house is a detached building, a horse-wheel is often placed in a shed outside the churning-house. The presses for squeezing the curd (in making cheese) are placed in this room. As the temperature of the milk in the churning-room requires to be regulated, a steam pipe is introduced from the boiler in the scalding-house, and applied to the churn. The temperature of the milk-room may be regulated in the same way.

"*The Scalding-room* should be a roomy apartment, properly fitted up with a steam-boiler and copper, a rinsing tank and sink. The floor should be paved with stone or brick, set in cement, and should have a good fall in every direction towards the drains. An unlimited supply of water should be provided for this. Outside the building it is as well to have a lean-to shed, with benches, upon which are placed the milk-pans, tubs, and other utensils, to dry.

"*The Cheese-room* is usually placed in the upper floor of the dairy-house. It must be dry and airy, or the cheeses will dry unequally, and have a spotted appearance, besides being apt to heave. Cheeses should not be salted in this apartment, nor should wet and dry cheeses be placed together, or much injury will be the result. Shelves should be placed round the walls, and a strong wooden framing should be constructed in the centre, fitted with shelves, upon which the cheeses are placed, and in such a manner that easy access may be had for the purpose of continually turning them."*

The above is calculated for a farm of moderate pretensions, but the following, which is taken from the *Farmers' Magazine*, is a description of a dairy belonging to Mr. Littledale's farm at Liscard, in Cheshire, and must be considered a first-class establishment of the kind:—

"The dairy adjoining (the house) is the most perfect and beautiful we have ever seen. It is a large oblong square room, elegantly and usefully fitted up. The floor is formed of Kean's patent cement, of a chocolate colour, and was laid in one piece; but, by white lines of composition introduced, let into grooves made on the surface, it resembles fine pavement in large squares. There are two tables, one on each side, made of sycamore, with turned pillar legs of the same, and the whole of almost snowy whiteness from washing. There is a massive marble table at the further end. Three

* "Agricultural Engineering," by G. H. Andrews.

very large octagonal-shaped leaden milk coolers stand in the centre, each on an ornamental pedestal. The walls above the tables, to the height of above 20 inches, are lined with glazed Staffordshire tiles, resembling small squares of veined marble. There are ten square ventilators round the sides. The roof is of the pavilion or curved form, groined, with a handsome foliated centre-piece, which, being in open work, leads the air to a large ventilator at the top of the building. The walls most exposed to the sun are built with a hollow space of 3 inches in them, through which a current of air passes, and there is a double ceiling, for the same obvious purpose of keeping an equal temperature in summer and winter. The milk dishes are all of glass, of various sizes, and both round and oval. These (glass being a non-conductor) are for the preservation of the milk, and, for throwing up the cream, are found to be superior to vessels of the usual materials. The room is, in fine, a perfect model of a dairy, in elegance, cleanliness, and adaptation. The milk kits, or pails in which the milk is brought from the shippons, are all beautifully made of sycamore, and are kept so clean that the wood, like the tables, is white and spotless, and the iron hoops of dazzling brightness."

Since the remission of the duty on glass, that material is frequently substituted for earthenware for milk-pans, both on account of its non-conducting property and its superior cleanliness, in which respects it recommends itself to every dairyman who is desirous of preserving the purity of the milk. The temperature most proper to be kept up in the dairy is from 50° to 55° of Fahrenheit. This causes the cream to rise readily, and means are easily provided in a properly constructed dairy for maintaining that standard.

The selection of the dairy stock is a matter of equal importance with the arrangements of the building. Not only is the class of cattle to be considered, but the purchaser should be able to judge, in some degree, by the outward appearance of individual cows, whether they are likely to be good milkers. Many persons are remarkably clever in this way, and can tell almost at first sight of a cow whether she is such or not. With regard to the breed most adapted to dairy purposes, we have already, in the account of the various breeds, pointed out their milking qualities; and it is much in favour of the short-horns that they have obtained a strong footing in all the dairy counties, and in London and other large towns. It is unnecessary for us to say any more on the subject here, and will therefore refer the reader to that part of this work which treats of the various species of cattle. And with regard to the points by which to judge whether a cow is likely to prove a good milker, we refer to a quotation from Youatt, at page 381 of this work, which we have found by experience to be correct. But as poetry makes a greater impression on most people than prose, we copy the following lines from the same author, as describing the good points of a cow profitable for the dairy:—

"She's long in her face, she's fine in her horn,
She'll quickly get fat, without cake or corn;
She's clean in her jaws, and full in her chine,
She's heavy in flank, and wide in her loin;
She's broad in her ribs, and long in her rump,
A straight and flat back without ever a hump;
She's wide in her hips, and calm in her eyes,
She's fine in her shoulders, and thin in her thighs;
She's light in her neck, and small in her tail,
She's wide in her breast, and good at the pail;
She's fine in her bone, and silky of skin,
She's a Grazier's without, and a Butcher's within."

Cows are known to improve as they get older, up to a certain age, in respect to the richness of the milk. The same author mentions an experiment made of six cows taken promiscuously from the herd, and a quart of milk of each being tested, produced the following quantities of butter:—

No. 1	. . . . . .	3 oz. 6 dwts.
,, 2	. . . . . .	1 ,, 6 ,,
,, 3	. . . . . .	1 ,, 12 ,,
,, 4	. . . . . .	1 ,, 10 ,,
,, 5	. . . . . .	1 ,, 14 ,,
,, 6	. . . . . .	1 ,, 6 ,,

The cows were of the improved short-horn breed, and No. 1 was six years old, the other five only two years old. Some persons think that a cow that fattens readily is not good for the dairy. Experience has proved the contrary of this; and that a cow with good grazing points, and that keeps herself in fair condition, is generally found equally good in her milking qualities. This is an important consideration, because when her age or an accident lessens her profitable retention in the dairy, she will rapidly be prepared for the butcher. These remarks apply more strongly to the short-horns than to any other breed, except the Alderneys, which, however, are rather noted for the richness than the abundance of their milk; and they are, besides, too tender for our cold and damp climate.

The food of milch cows cannot be too succulent or too rich. It is a question, however, whether very rich pastures will not pay better by fattening bullocks than by feeding cows. At any rate, there is no economy in stinting cows in their food, or in keeping a larger number than the pasturage can fairly support. In Cheshire they say, *as a rule*, that the worst land produces the best cheese; and that rough, damp meadows, where the grass is not of a fine quality, but abundant in quantity, are better calculated for the dairy cattle than the dry upland pasture.

All the trifoliated tribe of plants are good for cows; but the most approved of the present day is that called expressly Cow-grass, which we have described in the section on the artificial grasses, at page 514. Stephens denounces this plant on account of its propensity to throw out lateral shoots, and, ultimately, to destroy more valuable grasses. Lawson, however, recommends it as a useful plant, and it is now extensively cultivated not only in France and Germany, but in the United Kingdom, which seems a confutation of the opinion of those who object to it. Upon the principle of feeding cattle on the soiling system, the possession of natural pastures for summer feeding is not required to any large extent. A few acres near the establishment, to turn the cows into occasionally for fresh air and exercise, are all that is necessary, the food being supplied to them in their stalls or *byres*. We have mentioned the names of Curwen and Harley as the founders of the soiling or stabulation system, both of whom published an account of their plans. The latter conducted his dairy at Willowbank, near Glasgow, for six years, with great success and satisfaction, when the peace of 1814–15, by the depression which resulted from it in every department of industry, compelled him to give up his dairy. At that period he had 300 cows, and found ample demand for all the milk they produced, which he made a point of selling pure and unadulterated. With him, therefore, the system was not a mere experimental one, but a genuine and prosperous business, and we are led to conclude that it was the losses and depression in his other and more extensive engagements that compelled him ultimately to relinquish his dairy.* The large scale on which it was conducted, and the success that attended it, might have led him to claim originality; but he declares Curwen to have been his exemplar, if not his model, and ascribes to him the merit of being "the father of the soiling system."

Mr. Harley commenced forming his dairy in 1810, in order to supply the town of Glasgow with pure milk. He had previously purchased some land at Willowbank, in the suburbs of Glasgow, on which he erected a building to hold twenty-four cows; but the demand so rapidly increased for his milk, that he extended the buildings to accommodate 300 cows, and actually had, in 1815, 260. The establishment became so popular, that a large number of persons constantly visited it, and the public were at length admitted by ticket, for which they were charged a shilling each. Mr. Harley states in his work that it produced £200 per annum. A great number of the nobility, both English and foreign, resorted thither, and expressed their approval of the system on which it was managed. It is unnecessary to give a detail of the plan on which the Willowbank dairy was conducted, so much improvement has been made in the system of soiling cattle of all kinds; but we may justly ascribe to Mr. Curwen in England, and Mr. Harley in Scotland, the origination of the practice, and especially to the latter, as having carried it out for several years on a large scale with complete success. One peculiarity, however, of the system we may mention as worthy of imitation at all times when necessary. "The usual mode of curing a surfeit in the Willowbank dairy was to take the vessel (in which food was given) from any cow that appeared to have little inclination for food. Her stall was then marked with chalk, to prevent mistakes; and at next feeding-time an empty dish was set before her. This practice was continued until the animal showed something like keenness of appetite, when a small quantity of food was given her, which was afterwards gradually increased to the extent of the customary meal."

Dr. Gregory, of Edinburgh, sent a gentleman to Glasgow to learn if the cows were subject to any disease under the confinement, and was informed that the ventilation was so complete, and the rules so strict with regard to cleanliness and food, that there never was any general disease. On being informed of the above practice for surfeit—"Ah," said he, "that's just the doctor's grand specific for complaints of the human stomach;" and he then related the following anecdote of a patient who had applied to the doctor for advice in consequence of having lost his appetite. He was a rich Glasgow merchant, and for a long time had been a noted punch drinker. The doctor heard all his symptoms, and then prescribed as follows:—"*Prescription*—To get up at 6 o'clock a.m., and walk round the public green, or down to Govan (a village about three miles from town), till breakfast time; then to take a crust of bread or toast, and *smell it*, but not to taste it; next, go to your ordinary business, taking care to walk again before dinner, as he had done in the morning. At dinner-time to take another crust, or piece of toast, and chew a little of it, but not to swallow even the smallest particle. To go to business again in the afternoon, and, finally, to go to bed without supper. Next morning, to take a similar walk round the green; and then, if inclined to eat, to take a little, *very little* breakfast. By following this rule," said the doctor, "and abstaining from *Glasgow punch* altogether, I will guarantee that you will very soon regain your appetite."

There is so much of both philosophy, science, and common sense in Dr. Gregory's

* At least, we infer from the preface to the work that such was the case, although it is not distinctly so stated.

prescription, that we have been induced to give it in full, being persuaded that in the large majority of stomach complaints, whether in man or in the inferior animals, the cause is repletion, and may certainly be neutralised by its opposite—*abstinences,* to which, however, there are few would submit, to the extent laid down by the worthy doctor. Abernethy's prescription for a London alderman, under similar circumstances, was of the same character:—"Go home, sir, and live on eighteenpence a day, *and earn it.*"

The dairy farms near large towns are nearly all employed in supplying the populations with fresh milk, for which there is a constant demand, morning and evening, the surplus only being made into butter and cheese, and as the number of cows kept is usually in proportion to the demand for milk, the surplus is at all times very small. On the contrary, on the large dairy farms in the country, the whole produce of milk is converted into butter and cheese; and in some of those in Cheshire, Gloucestershire, and Derbyshire, nearly the whole is employed in making cheese, for which those counties are famous. The richness and large extent of the natural pastures, particularly in the Vale of Gloucester, which is, perhaps, one of the richest tracts of land in the kingdom, renders these districts peculiarly proper for the purpose. It is estimated that nearly nine-tenths of the land of the vale is under grass, and the proportion of cows kept is twenty-five to every 100 acres, besides the heifers and young stock reserved to fill up vacancies in the dairy. The heifers usually have their first calves at three years old, and will continue in their prime from four till eight or nine, when they are usually fattened for the butcher, because after that age the milk is considered to deteriorate in quality, whilst they consume a greater quantity of food without increasing in the production of milk. They are, however, generally sold as *farrow* cows instead of being fattened on the farm, it being considered that the pastures pay better for milk than for meat. About one-fourth of the dairies are thus annually turned out, and as they are generally in good condition, they fetch from £8 to £12 each, according to their size and weight.

To fill up the vacancies occasioned by this annual abstraction of the dairy stock, the farmers either rear from their own stock the requisite number, or they purchase three-year-old heifers in calf; but they prefer the former mode, as they can select from the progeny of their best cattle, which is no small consideration. The calves are taken from the cow at a week old, and for the first month receive two quarts of milk each, morning and evening. After this the milk is reduced to one quart, and half a pound of meal, morning and evening, which is continued for six weeks longer, when they are turned into the richest pasture to help themselves. The bull calves are either sold when weaned to the upland farmers, or at a few days old to the butcher, none being reared on the dairy farms. The average price they fetch is about 15*s.* each.

The quantity of pasture allowed to each cow is an acre and a half, from the 1st May to the 30th November; and the hay of the same quantity of land will support them the other five months. When not in milk, barley straw is given them with hay. As no turnips or mangold-wurzel are raised on the farm for them, they are fed entirely with grass in summer, and hay or hay and straw in winter. The expense is estimated at £4 for the summer, and £5 for the winter keeping. And as no meal or oil-cake, or any other artificial food is given to them, their food is wholly natural, and no means are employed to increase the quantity or to improve the quality of the milk by rendering it richer. Neither is any shelter provided for them or the young stock during the winter, beyond that of keeping them in inclement weather in the most sheltered fields, when the hay is given to them on the ground or in racks, but, in either case, at a great waste of fodder. When near calving, they are taken home, and placed in sheds or yards, and supplied with the best hay. If there is not room for them in sheds, they are kept in an orchard or home-paddock, convenient for milking, and more sheltered than the open fields.

As soon as the grass in the pastures is high enough to afford the cattle a good bite, they are turned into them. This is about the beginning of May—those fields which lie nearest to the homestead being generally devoted to the milch cows, to avoid having far to drive them to and from the milking, which would both lessen the quantity and injure the quality of the milk, and the cheese or butter made from it. The cows are supplied with fresh pasture by frequent changing of the fields, whilst one or two of these are shut up to get freshened; and thus every ten or twelve days in the summer they have fresh grass to go to. In the autumn they eat down the after math of the meadows in which the hay has been saved, which usually affords an abundance of succulent food. It is a nice point to calculate the number of cattle a dairy farm will support. If over-stocked, the grass will be scanty and foul; if under, coarse and ill-flavoured, which will injure the quality of the milk.

Gloucester cheese, which is called "single" or "double Gloucester," according to the thickness, is of a mild flavour, and is consequently preferred by young persons and females to the more pungent flavoured Cheshire cheese. The following is the process of making it:—

The temperature of the milk should be 85°, and in cold weather it is necessary to warm a part in order to bring the whole up to the standard. The rennet being then added, it is allowed to remain still for an hour, covered with a woollen cloth to exclude the air. The curd being formed, it is broken up by passing a three-bladed knife, or a coarse wire-sieve, down to the bottom of the tub. When the curd is sufficiently comminuted, the whole is allowed to remain for ten minutes, that the broken curd may sink to the bottom, and the whey be poured or baled off. When all the clear whey is removed, the curd is broken a second time, slowly, to avoid pressing out any of the richer parts, of which there would be some danger if the curd were roughly or rapidly broken. When reduced to a regular fineness, it is left to settle for a short time, that the whey may rise to the top, which is then taken off, and poured through a strainer, in order to divest it of all particles of curd suspended in it. The curd is then separated into lumps, and these are placed one upon another at the bottom of the tub, which is tilted to draw off the remainder of the whey. When this is effected, the curd is rubbed and salted. A clean cheese cloth is then spread over the vat, and the broken curd is packed into it by hand, and heaped up in a conical form above the vat. It is then pressed equally down, and the cloth is brought over it, and folded as smoothly as possible. A board the size of the inside of the vat is then placed on it, and the whole is put under the cheese-press, and slightly pressed for about half an hour. It is then taken out, and again broken in pieces; and this is repeated as long as a drop of whey can be extracted by the press. The next time the vat remains for two hours under the press, when it is finally taken out, and the cheese, having acquired the proper degree of firmness, is pared at the edges, and put into the last and the most powerful press, where it remains twenty-four hours. It is then taken out and salted, the salt being rubbed by hand all over the outside as long as it will imbibe it. It is then wrapped in a dry cloth, and again placed under the press. In twenty-four hours more it is again salted, after which it is put in the press without a cloth, and pressed, in order to give it a smooth surface. It is afterwards salted a third time, and another turn of the press being given to it, it is then removed to the drying-room, which is properly devoted to this purpose alone. Here the cheeses are placed upon racks, shelves, or the floor, as the case may be, and wiped with dry cloths, and turned twice a day for about two or three days, and then for a month longer once every day. At the end of that period they are scraped and painted, and are then ready for the London market.

A more rational and humane system of treatment of cattle is pursued in the dairy farms of Cheshire, where the cows are lodged in stalls or *shippons* from 1st November to the 1st May, except that they are turned out into a pasture for a few hours, if the weather is fine, for air and exercise. They are also turned out to water twice a day, and this is sometimes all the exercise they get. One-third or one-fourth of the land is kept under the plough for growing winter food. The allowance of pasture is two acres to each cow, besides the after math of the meadows off which the hay has been taken. If bone manure is employed, an acre and a half is found sufficient, and about the hay of half an acre for the five winter months. Both Swede turnips and mangold-wurzels are grown for the cows, but they are rarely given to them, except in small quantities a week or two after calving, when about 30 lbs. are given to them daily, and about 1 cwt. of hay per week.

The expense of keeping a cow in Cheshire is much the same as in Gloucestershire, that is, £9 per annum—£3 10*s*. for the summer, and £5 10*s*. for the winter months. No, or very little, butter is made, the milk being nearly all converted into cheese, for which this county is famous. The average quantity yielded by each cow is 3 cwts. per annum, and that of the richest quality. Some dairies are said to produce as much as 5 cwts. per cow, but these are rare cases, being also exclusive of what is given to the calves and used by the family, of which latter there is no stint.

The cows are almost universally allowed to graze in summer, and are stall-fed in winter. In the latter season they are fed with cut straw and hay, mixed with linseed, and boiled in fifteen times its volume of water, with the addition occasionally of bran or oatmeal. Mangold-wurzel is given to the cows in milk, and a larger allowance of bran and meal. 18 lbs. of hay and 40 lbs. of roots daily, or 24 lbs. of hay without the roots, are given to each cow. If straw only is given, they have 80 lbs. of roots.

Cheese-making is somewhat differently conducted in Cheshire from what it is in Gloucestershire. The evening's meal of milk is kept in basins or coolers till the morning, when the cream is skimmed off, and about half of it is warmed up to 100° in a shallow pan. It is then with the morning's milk poured into the cheese-tub, and the part of the evening's milk not warmed, and the cream taken off, are added to it. The temperature is now from 80° to 85°, and the rennet and annatto, or colouring matter, are put into it, and well mixed with it. About half an ounce of annotto is sufficient for 75 lbs. of cheese. When the rennet is applied, the tub is covered up for an hour and a quarter, when, the coagulation being complete, the curd is broken, and allowed to rest a quarter of an hour, to separate from the whey, which is taken out by pressing a flat-bottomed pan upon it until it is filled. The curd is then again broken, either with the "breaker" or by hand, and again allowed to settle, pressure being applied to it by placing a board on it with weights, of from 60 to 120 lbs., to press out the whey. When it has become solid, it is cut and turned over in slices several times to draw off the whey, and then again weighted as before, which operations occupy about an hour and a half. It is then taken from the tub, as near the side as possible, and broken very small by hand, and salted. It is next put into a cheese-vat made deeper by a tin hoop to hold the quantity, it being more than the bulk when finally put into the press. Then squeeze the sides well by hand, so as to raise it to a conical form in the centre, on which place a board, as in the case of the Gloucester cheese, well weighted. Small holes are pierced in the vat, into which skewers are run to the centre of the cheese in order to give vent to the whey. When this has ceased running, shift the cheese out of the vat, and, putting a clean dry cloth over it, reverse it into another, or the same vat cleaned by scalding. The top part should then be broken down to the centre, salt mixed with it, pressed by hand, the board again replaced and weighted, the holes pierced with the skewers, and thus the whey all extracted. When it has ceased dropping, it is again reversed into another vat, scalded as before, and with a cloth under it. A tin hoop is inserted into the upper edge inside the vat, the cheese being first enclosed in a cloth. All these operations occupy the time from seven a.m. to one p.m, when the cheese is finally put into the press, and a pressure of from 15 cwt. to a ton applied to it, thin wire skewers being stuck round it, and occasionally shifted. In four more hours the cheese should be turned in the vat, and again the next morning, and this should be repeated twice more at intervals of twelve hours. The process of salting, cleaning, trimming, &c., as we have described in the case of the Gloucester cheese, is then gone over, and the cheese is finally lodged in the cheese-room on straw, and turned daily until it is perfectly dry and firm.

The more varied the plants, and the richer the soil of a dairy farm pasture, the better. Cows are fond of a variety in their food, and the butter is of a finer quality from such pastures. Clover and Italian rye-grass, especially the latter, which comes in some time before any other fodder, are excellent food for the dairy cows, but not much of these are grown in Cheshire or Gloucestershire. The use of bone-dust for pasture land is increasing in Cheshire, it having been found that 75 acres of land dressed with it will support as many cows as 100 acres not dressed with it. The more a dairy farm is divided into moderately small enclosures the more cows will it support, and the better will be the produce, because it enables the occupier the more frequently to change the pasture for the cattle, by which the grass is always kept fresh and clean—a matter of great importance to the purity and sweetness of the milk, and the butter made from it.

It is estimated that from half to one-third of the food of a dairy farm is saved by soiling the cows, there being no waste if common care and attention is paid to it. One cwt. of green food per day is amply sufficient in the summer for a cow, and Italian rye-grass will yield, at only two cuttings, 8 tons per acre; but it is sometimes cut three, and even four times, when it has been brought forward early in the spring by high manuring. Then, in the winter, by cooking the roots and giving cut hay and straw, there is no waste, and a smaller quantity of food is consumed. On the other hand, the dung is more valuable and the milk is richer in quality, and one-fourth greater in quantity. In Gloucestershire they estimate the average yield of a cow at 525 gallons per annum, but under the system of stall-feeding they obtain 680 gallons.

The building in which the cows are stalled should not be less than 17 feet in width, with length in proportion to the number of cows to be kept in it. The breadth is divided into byres according to the following scale:—

Passage in front of the stalls for supplying food	$3\frac{1}{2}$ feet.
Manger	2 ,,
Stalls	6 ,,
Drain	$1\frac{1}{2}$,,
Passage behind the cows	4 ,,
	17

The byres should be clean swept twice a day at the least, and all dirt and litter sedulously removed. The feeding should also take place twice a day, and not more should be given to the cows than they can eat in the interval, as it must otherwise either be wasted or cows will blow over it, and it will deteriorate the quality of the milk. The food of cows cannot be too fresh or too sweet. For this purpose the cow pastures should be occasionally examined, and all plants that are likely to give a disagreeable flavour to the milk and butter should be carefully rooted out. One of the most common of these is saxifrage, the flavour of which may frequently be detected in both butter and cheese, but especially the latter. Decayed plants, also, should never be given to cows, for they invariably taint the milk, more or less. This is especially the case with half-decayed cabbage leaves, which impart a putrid flavour, and should never be suffered to get into the food of a milch cow, either in a raw or boiled state.

The Stilton cheese, so justly famed and appreciated, is made in Leicestershire, chiefly in the neighbourhood of Melton. The dairy farms in this county are of various sizes, some being as large as 500 or 600 acres, and from that down to 20 acres, but the average is about 200 acres. The quantity under tillage is greater in proportion than either in Gloucestershire or Cheshire, consequently the number of cows kept is smaller. The breeds of cattle kept are the long-horns and the short-horns, or a cross between them; and these are preferred on account of their aptitude to make flesh while in milk, so that when dry, if they are not first-rate milkers, they will the sooner be ready for the butcher. Like the Gloucestershire dairymen, however, some of those of Leicestershire never keep a cow after the third calf, in order to preserve the produce at the highest state of perfection; and this practice also induces them to keep the cows forward in flesh, especially towards the close of the period of their being discharged from the dairy herd.

The mode of feeding the cows is very similar to that practised in Cheshire. They are allowed to graze in summer, but are stall-fed in winter. As more land is cultivated in this county on dairy farms than in either of the others we have spoken of, a more liberal allowance of roots (mangolds) is given to them, as well as of green food, in the spring. They allow each cow 3 acres of pasture from 1st May to 1st October; and as their dietary in winter is much more expensive, it is estimated that the whole season does not cost less than £15 per head, including attendance, utensils, and interest of capital. The annual yield in cheese is from 360 to 500 lbs., exclusive of the milk given to the calves and used in the family, which, it is estimated, would raise the produce of cheese to 500 lbs. per year, the proportion generally obtained being 1 lb. of cheese to each gallon of milk. The following is the method of making Stilton cheese:—

The evening meal of milk is set, and put to that of the next morning, with the rennet; or sometimes the cream is skimmed from the former, and alone put to the latter, with the rennet, the temperature being raised, if necessary, by artificial means, to about 81°. When the curd is formed, which should occupy about an hour and a half, it should be taken out, *unbroken*, and strained in a sieve or straining cloth. This process should be gradual, during which a gentle pressure should be used, till it becomes dry and firm. It is then placed in a vat or box exactly the size of the intended cheese, to prevent its bulging out or breaking in pieces again. Sometimes the whey is squeezed out by pressing it when in the strainer by twisting it round, and, when dry enough, is cut into pieces and put in the mould, a clean strainer being put next the sides of the mould. Salt is sprinkled between every layer, and holes are made in the sides of the box to let the whey still remaining drain off. The next morning it is taken out, and fresh cloths being put in the mould, the curd is inverted, and placed in it again; and this is repeated until, all the whey having drained out, the curd becomes firm. During this draining process, the temperature ought to be kept as high as 100°, in order to extract the whey and dry the curd. Perfect cleanliness is absolutely necessary to prevent the curd from acquiring a rancid flavour.

When the cheese has acquired the requisite firmness, it undergoes a trimming, by paring off the inequalities, and, with the excess, filling up the interstices between the slices. The top and bottom are also pared from their excrescent parts. A piece of canvas is then wound twice or thrice round the cheese, and it is placed on a clean cloth on a shelf. This cloth and canvas are changed every morning, and the cracks in the sides filled up, until the outside becomes dry and wrinkled. It is then taken to the drying-room, where it is daily turned and brushed to preserve it from mites and fly-blows, of which, in warm weather, it is in danger. This process continues for three months, after which the cheese is ready for sale.

A considerable quantity of whey-butter is made in Cheshire and other counties, being churned from the whey taken from the curd. *Green whey* is that clear liquid taken out of the cheese-tub, whilst the *white whey* is what is expressed from the curd by hand and the weighted board after the curd is put into the cheese-vat. In some cases the "thrustings," or white whey, is set in cream vessels to acidulate for churning, in a room heated either by the summer's sun, or by artificial means, if the weather is cold. In other instances both kinds of whey are boiled together, or rather are kept *below* boiling point, but sufficiently hot to cause the oleaginous matter to separate from the whey and rise to the surface. If the whey is acid, this takes place in about an hour; but if sweet, it should be artificially acidulated slightly to promote the separation. In other respects the process of making whey-butter does not differ from that of making butter from milk or cream.

The making of butter from the milk or cream is much better understood now than formerly, when a difficulty in "making it come" was ascribed to witchcraft or fairycraft, of either of which the dairymaid stood in wholesome fear, without suspecting, or, at least, without acknowledging, that she herself had been the cause by her negligence or ignorance. At present, in all dairies belonging to persons with any pretensions to modern agricultural civilisation, butter-making is reduced strictly to a science, the rules of which, if properly attended to, will infallibly be the means of producing good butter in the proper time, according to the season and the state or temperature of the weather. These, however, are of less moment now than of yore, because means are used, by artificial heat, to sustain a given temperature at all times when required. The following rules may be depended on for ensuring success:—

Before preparing to churn, see that the churn itself is perfectly clean, and free from all rancid or other smell, which usually arises from its not having been properly scalded after the previous churning. If not perfectly sweet, rinse it with boiling water, and afterwards with cold water, if in summer, but this should be omitted when the weather is cold. When this is done the churn is ready for the cream, which in winter may consist of that of three meals of milk, skimmed off when it is twenty hours old, and placed in a glazed earthenware or glass jar. The milk should never be allowed to turn sour before the cream is taken off; but it is of no importance that the cream afterwards becomes sour, as it will not at all affect the quality of the butter. When milk is placed in dishes the cream must be skimmed off; but if in *milk-leads*—that is, square wooden frames about 3 inches deep, lined with lead or zinc, and having a hole at one corner fitted with a spigot—there is nothing to do but to place a pail under the hole, and take out the spigot. As the cream swims at the top, the milk may thus be clean drawn from it, by watching that none of it escapes at the close of the process with the last of the milk.

We see no reason why plate-glass should not be substituted for metal for lining the wooden trays. It would not matter how coarse the glass is, provided the surface is polished, which can now be accomplished by machinery at a small expense. No other material can equal glass in purity, cleanliness, and entire freedom from retaining any smell noxious to butter.

In summer the milk should not stand more than from twelve to eighteen hours before the cream is taken from it. Before pouring it into the churn, it should be strained through a cheese-cloth strainer, placed over the opening of the churn, by which all the impurities that may have got into it are taken from it. A thermometer is an indispensable instrument in a modern dairy of any pretensions, to regulate the temperature in the different operations. In cream ready for churning, the thermal degree should be 55° Fahr. If it is higher, it requires great care, by a slow motion, to prevent the churning from bursting, which will injure or destroy the butter. In summer the process of "making the butter come" is much quicker than in winter, seldom exceeding half an hour or forty minutes. A good deal, however, depends upon the tact, skill, and carefulness of the dairymaid, or the man employed to work the churn. The former may, by her neglect of attending to the degree of heat of the cream, or in keeping the churn in order, and the latter by an irregular motion of the churn, not only protract the time, but injure the quality of the butter. When a locomotive steam-engine is kept on a farm, and the dairy is large enough to render it available, that power is now applied to the churning of butter with the best effect. By it a regular motion can be preserved, superior to that of animal or hand power. A horse wheel is sometimes used, but this is liable to even more casualty in regard to regularity of movement than hand-churning. Being generally superintended by a boy, it is a rare chance indeed if he maintains a regular motion with the horse.

As soon as the butter has formed in lumps, it should be taken from the churn and placed in a tub made for the purpose. Cold water is then poured over it, and it is kneaded by hand in the water to extract all the butter-milk. Fresh water is applied to replace that, and so on until the water remains perfectly clear from cloudiness, which is a proof that none of the butter-milk remains. A machinist* has invented a machine which, at one movement, instantaneously separates the butter-milk in the most perfect manner, saving a great deal of time, and preserving the purity of the butter, which is sometimes endangered by a hot-handed dairymaid—not to say an untidy one, which is as much the fault of the mistress as of the maid. In fact, no farmer ought to establish

* This is the firm of Hancock, the inventor of the pulveriser plough which we have described.

a dairy on his farm whose wife and daughters (if he has any) are too genteel to attend to the business of the dairy; and we would recommend such fine ladies to read attentively a spirited little work entitled "Our Farm of Four Acres," by which they will learn that such employment is not at all incompatible with the highest degree of refinement or of literary taste. That little work, in fact, is a model for farmers' wives of every grade, and shows the importance of a knowledge of science for the proper management of the dairy.

When the butter is divested of the butter-milk, it is worked up into whatever fanciful forms the custom of the country, or the ingenuity of the dairymaid, may devise. Thus, in Norfolk, butter is put up into pints and half pints; in Cambridgeshire it is brought to market and sold by the yard, half yard, and quarter yard; but the most usual form is that of the pound and half pound, either plain or stamped with various devices of birds, beasts, plants, &c., &c. Sometimes a little salt is worked into the butter, but in London the people prefer it perfectly fresh, except the Irish firkin butter, which is usually salted with the view of its keeping through the whole season. No other butter than the Irish has been found to stand the voyage to either the East or West Indies, and even that becomes rancid after its arrival, which the inhabitants soon become accustomed to.*

There are various ways in which butter may be injured in churning. If it "bursts" it will be soft and frothy; and the same if churned too quick in hot weather. In these cases, it never becomes firm, and will not keep half the time of good butter. If it is churned beyond the time that the butter is formed, it will also be soft, and will not keep long. In summer the temperature of the atmosphere is generally sufficiently high to keep the cream warm enough for churning without artificial heat; but in winter it is necessary to raise the temperature by boiling a portion of the cream to be put into the churn with the rest.

In Ireland the dairymen churn the whole of the milk without skimming off the cream; and it is said that the quantity of butter produced by this method is greater than from the cream alone. The upright churns worked by hand are chiefly used in that country. The milk as it comes from the cow is put into barrels, and kept twenty-four hours. It is then put into the churn, raised to a temperature of 70° or 75° by the application of hot water. The churning in this way is much more tedious than when the cream alone is churned.

No certain method has been yet discovered of curing tainted or rancid butter. This is because no chemical preparation can touch it on account of its oleaginous property, except an alkali which would convert it into soap. It may, however, be improved so as to be fit for making pastry, by putting it into clear, cold spring water, and setting it over the fire until it boils, when it should be skimmed off and set to cool in jars, taking care to draw off all the water from it when it again becomes solid. It should be used immediately, or it would probably again become as bad as ever. The act of boiling will dissolve the unpleasant acids to some extent, and cause them to evaporate.

The proportion of butter obtained from a given quantity of milk depends upon the breed of cattle and the quality of the pastures. Lord Kames states that a good cow will give on an average, during the six summer months, twelve Scotch pints of milk daily;†

* A relative of the writer's, who had lived for many years in the West Indies, when she came back to reside in Norfolk, could not eat the Norfolk butter, "*it was so fresh and tasteless!*"

† The Scotch pint is equal to four English pints.

and that the butter from it, with the skim-milk, may be worth eighteenpence per day. This is rather an apocryphal produce, and so thought the editor of the sixth edition, who, in the Appendix, states that half the quantity of milk stated by his lordship would be nearer the average. The following recipe for preserving butter is given by Dr. Anderson :—"Take of sugar one part; of nitre, one part; and of the best Spanish great salt two parts. Beat the whole into fine powder, mix them well together, and put them by for use. One ounce of this is to be thoroughly mixed with every pound of butter as soon as it is freed from the milk, and then immediately put into the vessel designed for it; after which it must be pressed so close as to leave no air-holes. The surface is to be smoothed and covered with a piece of linen, and over that a piece of wet parchment, or of fine linen that has been dipped in melted butter, exactly fitted to the edges of the vessel all round, in order to exclude the air as much as possible. When quite full, the cask is to be covered in like manner, and a little melted butter put round the edges, in order to fill up effectually every cranny, and totally to exclude the air. If all this be carefully done, the butter may be kept perfectly sound in this climate for many years. *How many* years I cannot tell, but I have seen it two years old, and in every respect as sweet and sound as when only a month old. It deserves to be remarked that butter cured in this manner does not taste well until it has stood at least a fortnight after being salted; but after that period has elapsed it eats with a rich marrowy taste that no other butter ever acquires; and it tastes so little of salt, that a person who has been accustomed to eat butter cured with common salt only, would not imagine it had got one-fourth part of the salt necessary to preserve it."

The rearing of calves, whether for the butcher or for the stock, forms an important branch of dairy economy. In feeding them for the butcher various plans are adopted. In Scotland they are kept for many weeks, the youngest having the first drawn new milk, and the older ones the last drawn, which contains a much larger proportion of cream. By this means the cows are fattened up to a large size for the Edinburgh and Glasgow markets. In Ayrshire the dairy farmers pride themselves on the fatness of their calves, and sometimes raise them to the value of ten pounds. In Ireland, on the contrary, they invariably kill the calves intended for the butcher at a few days old, but the veal is never good, being flabby and tasteless.

When a calf is first dropped, it should be fed with the *beistings*, or the first milk drawn from the cow. This has more consistence than the after milk, and is peculiarly adapted to strengthen the young animal. As it is seldom strong enough to suck of itself, it must be fed with it by hand, and as much given as it will take. In a few days it will have learned to drink, and should have as much sweet milk given to it as it can drink, which will be about eight quarts a day, at three meals, the first month, for which purpose the cow should be milked three times a day. After the first month, the cow should be milked, and the calf fed, only twice a day. This should continue till it is three months old, when they should be put into a pasture to be weaned; but if it is weak it should be kept longer on milk. In order to facilitate the weaning, its appetite should be stimulated with linseed jelly, clover hay, sliced turnips or carrots, or a little pounded oil-cake, with as much water as it will drink at all times. In order to rear first-rate cattle, the calves should not be either stinted in quantity of food, or cheated in the quality. Some dairymaids make a point of giving them part skim and part sweet milk; but it is impossible that they should thrive as well under that practice as with wholly new milk. When weaning, they should have a full bite of grass, as they are unaccustomed to shift for themselves, and must have their food ready provided, without the trouble of seeking it. Nor should they be deprived of the milk all at once, but by degrees, otherwise they will pine for it, and go back so much in flesh that it will be difficult to fetch them up again to their former high condition.

When calves are allowed to suck the cows, one cow is generally made to support two calves. The objection to this plan is, that the cow seldom allows herself to be milked by hand afterwards. On this account some dairy farmers keep cows on purpose for suckling calves; and if the cow has had her own calf early in the season, and is good at the pail, she will probably be able to rear two sets, that is, four calves, before her milk falls off too much for the purpose. Each calf should have a separate stall or crib, in order to prevent them acquiring the habit of sucking each other's ears and other parts, which does them both harm.

At three weeks old those bull-calves which it is not intended to rear entire should be castrated, it being considered as attended with less risk, and probably with less pain, than when they are older. After the operation (which should be performed by a veterinary surgeon) the calf should be laid upon some straw, and it will be stiff and sore for some days. It should be watched to see that no undue degree of inflammation or swelling of the parts takes place. Should it do so, fomentation should be applied with warm water. If the parts suppurate, which, however, is a rare occurrence, they should be opened for the discharge of the matter. Heifers are never spayed now, as they formerly were, under the supposition that they fattened much faster.

Some breeders begin giving their calves solid food at a much earlier age than others. At three weeks old they commence by giving them cut hay, linseed cake, and sliced turnips, diminishing the allowance of milk in proportion as the animals consume the other food. During their first summer they are fed with vetches, Italian rye-grass, &c., and an allowance of cake—from 1 to 2 lbs. daily. As soon as the turnips and Swedes are ready, and the green food begins to fail, those roots should be substituted, and a full allowance of oat straw, with 2 lbs. of linseed cake, per day, as with green food. The cake should never be withheld from them, as it not only nourishes them, but keeps them in good health, and prevents the disease called the *black-leg* from attacking them. Young stock reared in this liberal manner make great progress; and many are exhibited at the cattle shows of the Smithfield, and other agricultural clubs, of large size, and fat enough for the butcher at two years old.

There is no economy in keeping young stock on short allowance, or in a niggardly way, for the sake of rearing a large number. We know of no worse system than for a farmer or grazier to overstock his land; and it will be far better for him to have a field of turnips left at the end of the season, to be chopped up and ploughed in, than to have a parcel of young stock on short allowance of food, pining and bellowing for hunger; or turned possibly into a piece of pasture before the grass has commenced growing freely, to forestall the crop, and prevent its after luxuriance. No grazier who understands his business will purchase half-starved or half-fed cattle, if others are to be procured, for it will cost him as much to free them from the hidebound condition in which they necessarily are, as it would to prepare a well-reared lot for the butcher.

Young calves should never be turned out to grass when the weather is cold; and, until they are accustomed to the fresh air, a well-sheltered paddock is the best place for them to turn into for a few hours every day when the weather is dry, with a shed open to the south, but closed to the north and east, to which they can resort after feeding, to rest themselves. Some breeders prefer soiling them in a yard throughout the summer, giving them cut green food, and letting them have a run in a paddock for a short time.

Cows that, by reason of age or accident, decline in their yield of milk, or those that have missed having a calf, should be fattened at once, unless, in the latter case, there are special reasons to the contrary. Some cows naturally make flesh, after a certain age, too fast to allow of their continuing good milkers. Such animals should never be kept in a dairy, however rich their milk may be, because the quantity must necessarily be small, as a cow cannot gain much flesh and give an adequate produce of milk at the same time. Such cattle, too, will pay for fattening, and their abstraction from the dairy makes room for more profitable animals. Many town dairymen always fatten their cows when they fall off in their yield of milk from natural causes, and supply their places by purchasing three-year-old heifers ready to drop the calf, or that have recently calved, and have had their calves taken from them.

The quantity of milk given by cows varies considerably, as well as its richness. Stephens mentions instances of cows requiring to be milked five times a day, and others in which the quantity ranged from 12 to 25½ quarts per day, and one in which 45 quarts per day were yielded. A cow that yields half a pound of butter per day throughout the year, and gives 300 gallons of milk in the year, he considers a good one.

The period of gestation of the cow is generally reckoned to be nine months, but it is not certain to a few days. The late Earl Spencer kept a register of 764 cows, and found that the period ranged from 220 days, or seven months, three weeks, and three days, to 313 days, or eleven months, five days, reckoning in both cases the calendar month of twenty-eight days. Mr. Morton, however, considers 220 days a premature birth (as it certainly is)—dangerous to the calf, and, in fact, states he was never able to rear a calf at an earlier period than 242 days; and that any period of gestation exceeding 300 days must be considered irregular, though not necessarily fatal to the calf.* The time when the bull is admitted to cows should be carefully registered, so that the dairyman may know when to expect their parturition. The symptoms, also, of the approaching event should be watched, and preparation made for it. Generally the udder fills suddenly, and the vagina swells and looks inflamed, and a yielding takes place of the ligaments on each side the rump. It is usual on such symptoms appearing, to take some blood from the cow, and administer an aperient dose of medicine, in order to prevent her dropping the calf or *slinking*, in which case there is danger of her not getting rid of the *after-birth*, or *placenta*. This, if it accidentally remains, will soon become putrid, and a veterinary surgeon should be called in to assist in removing it as soon as the cow is delivered of the calf. We have known, in the case of ewes, when the placenta has not been removed at the time of parturition, that it has come from them piecemeal, in a high state of decomposition. In the case of the cow, Stephens recommends the following drink to promote the *cleansing*:—"Juniper berries, 3 oz.; bay berries, 2 oz.; nitre, 1 oz.; anise seed, 1 oz.; gentian, ½ oz.; gum myrrh, ½ oz.; asafœtida, ½ oz.—well pounded together for one dose, and given in one quart of mild ale, made warm in one quart of

* Skellett observes that where it happens that a cow goes two or three weeks beyond the usual period of gestation, the calf is invariably a male one; and that cows generally go longer with a bull than with a cow calf. See "Practical Treatise on the Parturition of the Cow," page 14.

pennyroyal tea." This drink should be given fasting, and repeated every day till the cleansing be evacuated. The cow should have plenty of warm drinks, such as warm water, gruel, and mashes of malt and bran, so as to keep the body gently open.

Cows that have once shown a tendency to this disorder are so liable to it in future that it is considered useless to attempt a cure; and the only alternative left to the owner is to obtain milk from her as long as she will yield it with profit; and instead of giving her the bull with the view of having another calf, to fatten her at once, unless her value as a first-rate type of her breed renders it desirable to preserve the stock. In that case Skellett recommends bleeding at an early period of gestation, keeping the body open with occasional cooling medicine, having gentle and regular exercise, and seclusion from other cattle towards the period of parturition. The food should be particularly attended to—neither of a costive nor a too laxative tendency, the latter being likely to produce the disease. She should be kept in *good*, but not *high* condition—neither so low as to reduce her strength, nor so high as to render parturition dangerous either to the cow or her calf; and, above all, keep her from contact with nauseous smells from other cows, which occur at certain seasons of the year. To prevent danger from this, Skellett recommends the following recipe, as used with great success by his father for many years:—Barbadoes tar, 3 oz.; balsam of sulphur, 3 oz.; rectified oil of amber, 1 oz.; fine oil of thyme, 1 oz.; animal oil, ½ oz. Mix them well together, and in using it a little is to be rubbed upon the parts where the cows commonly smell each other—to be repeated occasionally as it wears off the parts.*

Bleeding, we believe, is less practised now than when Skellett wrote his celebrated work, either in the case of human surgery or the veterinary art. Medicines have taken the place of the lancet, except in extreme cases, and such may probably occur in the subject under consideration; but blood-letting ought always to be under the direction of a skilful practitioner, and never entrusted to the hands of an empyric. It is the easiest matter imaginable to take a quantity of blood from a man or a domestic animal; but if injudiciously done, it may occasion irreparable mischief to the constitution.

Heifers should never be allowed to admit the bull at a less age than two years, although they will show a desire for it at even one year old. A remarkable instance of such precocity is related at p. 362 of this work, but such cases are rare, and the probability is that where they are allowed, or take place accidentally, the heifer is injured for life, and her growth stunted, whilst her progeny is weak, and seldom pays for rearing.

"Butter," says Stephens, "gives its richness to milk, sugar its sweetness, casein its thickness, water its refreshing property as a drink, and salts its peculiar flavour." The following are the proportions of these ingredients, according to the analyses of Henri and Chevalier, in 1,000 parts:—

	Cow's Beistings.	Cow's Milk.	Ewe's Milk.	Mare's Milk.
Casein	150·7	44·8	45·0	16·2
Mucus	20·0	—	—	—
Butter	26·0	31·3	42·0	traces
Sugar of milk	traces	47·7	50·0	87·5
Salts	—	6·0	6·8	896·3
Water	803·3	870·2	856·2	
	1,000·0	1,000·0	1,000·0	1,000·0

* "A Practical Treatise on the Parturition of the Cow." by E. Skellett, p. 74.

These constituents in milk are only mechanically mixed, which accounts for the rapid changes that take place in it; and it only requires rest and time to effect their separation; whilst the cream, which is the oleaginous and lightest portion, rises to the surface, the casein turns sour, and, after a time, causes the milk to coagulate into a mass, which again subsequently separates into two parts, the coagulation or curd becoming more solid, and the aqueous parts more thin and fluid, the former being cheese, the latter whey. "Milk," says Raspail, "when viewed by the microscope, with a power of only 100 diameters, exhibits spherical globules, the largest of which are not more than ·0004 of an inch in diameter, and which, from their smallness, appear of a deep black at their edges. These globules disappear on the addition of an alkali—such as ammonia—and the milk then becomes transparent. If the proportional quality of milk be more considerable, it forms a coagulum of a beautiful white colour on the addition of concentrated sulphuric acid. This coagulum does not arise simply from the adhesion of the globules to each other, but it may be plainly seen by the microscope that the globules are evolved in a transparent albuminous membrane, which has no appearance of a granular structure. Milk, then, is a watery fluid, holding in solution *albumen* and *oil*, by the agency of an alkaline salt or a pure alkali, and having suspended in it an immense number of globules, which are in part *albuminous* and in part *oily*. The albuminous globules must tend to subside slowly to the bottom of the vessel by their specific gravity, whilst the oily globules must have a tendency to rise to the surface. But the oily globules being dispersed in myriads amidst equally numerous albuminous globules, they cannot rise to the surface without taking with them a greater or less number of the globules of albumen. Hence, at the end of twenty-four hours, we find on the surface of the milk a crust composed of two layers, the upper one of which contains more butter than milk, while the lower contains more milk than butter. The separation will take place equally, with or without contact with the air. The liquid part which lies under the crust contains the dissolved albumen and oil, with a portion of the sugar, the soluble salts, and a certain quantity of the albumen and oily globules." *

In Paris, according to the same authority, the dairymen skim the cream from the milk, and substitute for it raw sugar and an emulsion of either sweet almonds or hemp-seed. Starch, also, is used, with the addition of carbonate of potash, to prevent coagulation. Sometimes magnesia is put into the cream by the Dutch dairymaids to thicken it. The adulteration of milk by some of the London dairymen, or their agents, the distributors, is sometimes carried to an enormous extent, and their diminutive cry of "*Mi., O*" is well defined to be a contraction of the French words *demi eau*, or half water! The pump is certainly the source of the most profit to many of the London dairymen or their distributors. It is also asserted that substances far more objectionable than water are sometimes put into milk that has been highly watered, to restore its colour and thicken it.

Although the constituents of milk are only mechanically mixed, the changes which they undergo in the processes of making butter and cheese are chemical. In churning, the milk becomes sour by the conversion of the sugar into *lactic acid*, which is supposed to dissolve the filmy coverings of the fatty globules, which then unite and form the solid mass of butter. The fat of butter consists of two substances, called *margarine* and *elain*, the first of which gives hardness, and the second softness, to the butter. There is, however, that analogy between these two elements that the *elain* is sometimes converted

* "Organic Chemistry," by M. Raspail, p. 380.

into *margarine* by the addition of 4 parts of oxygen absorbed from the air, or otherwise by 1 part of liquid elaic acid, giving off at the same time 2 of carbonic acid, and becoming transferred to *margaric* acid. These changes are, of course, essentially chemical, and they point out the very delicate character of the manufacture of butter, and the importance of possessing more than a merely practical knowledge of the art. It is for want of an acquaintance with the *rationale* of the operation of butter-making that we find so little of a first-rate quality; whilst those who conduct the process upon scientific principles never fail to have good butter. Our forefathers (and, we are sorry to add, some even in the nineteenth century) were wont, in their ignorance, to ascribe the failures in churning and cheese-making to supernatural causes, throwing all the blame upon the fairies or some unfortunate female who happened to be more destitute of personal charms than her neighbours, and was consequently deemed a witch. Science, which is pushing its ramifications into the most secluded parts of our country, has almost wholly dispelled these injurious illusions, and assigned such failures to their proper source—neglect, and ignorance of the principles on which the processes should be conducted.

Besides butter and cheese in their ordinary forms, there are various other preparations of milk and cream that furnish an agreeable variety in the dishes brought to table. Thus, the *clouted* or *clotted cream* of Devonshire, which has a wide, if not a world-wide reputation, is prepared by straining new milk into a shallow dish having a little warm water in it. It is then allowed to stand from six to twelve hours, after which it is carefully heated over a slow fire to *almost* boiling point, but not quite, as it would break the skin of the cream. The dish is taken back to the dairy, and the cream cooled, when it may be eaten either as butter or cream.

Cream in its ordinary form is used at table as a delicious accompaniment to fruit pies and puddings, and in a great variety of ways, well known to skilful housekeepers, and in none of which is it more grateful to all palates than with preserved fruits. *Iced cream*, flavoured with different kinds of fresh fruits—as pine-apples, raspberries, strawberries, &c.—are well-known preparations of the confectioner, and afford a cool and delicious refreshment in hot weather.

Cream-cheese may be made in the following manner:—Take one pint of cream, and mix it with twelve pints of noon-day milk, warm from the cow: add a little rennet, and when the curd comes, pour off the whey gently, without breaking the curd more than necessary; put it on a sieve, with a cloth or a strainer under it; change the cloth every hour during the day, and in twenty-four hours it will be made. It ought, however, to stand some time to ripen before it is eaten, which much improves the flavour. Stephens, on the other hand, says it will keep good only *one* day. This, however, is a matter of taste, and, from experience, we should prefer it after standing two or three days.

To make *hatted kit*, boil two quarts of milk scalding hot, and pour it quickly upon four quarts of fresh butter-milk. Let it stand till quite cold, and then take off the *hat* or skim, which will be quite solid: drain this in a hair-sieve, and put it into a shape for half an hour; then turn it into a dish, and serve it with cream and sugar. The slightly acid taste it has acquired in the process will heighten the zest in eating it.

SECTION X.

IRRIGATION.

The custom of applying water issuing from high ground to the irrigation of those lands below it, is one of such obvious utility, and so easily carried into effect, that it is a matter of astonishment it should be so little practised in England, which is considered to be, in other respects, the model country of good husbandry. Perhaps it may be ascribed, to a great extent, to that jealousy with which those persons who possess mill-races view what they consider to be encroachments upon their rights. Until some recent decisions disabused them of their pretensions, the millers generally considered all the water proceeding from the high grounds abutting upon their portion of the streams on which their mills were placed as their vested property, and any infringement upon it was sure to be followed by an action at law. These assumptions have been exploded by those decisions which have established the right of the occupiers of high lands to deal with the water on their own farms as they think proper; and the late Drainage Acts have further confirmed this right, and even enabled them to pass their drainage water through the lands of those farms below them, or to dispose of it in any way they may think fit.

In some of the English counties, however, where abundance of streamlets are found proceeding from the hills, irrigation has been practised for a great length of time. This is the case in Wiltshire, Gloucestershire, and Devonshire, where water-meadows have been formed for time out of mind That it should not have been adopted by other parts of the kingdom to a greater extent, must be ascribed in part to the cause we have stated, but chiefly to a want of knowledge amongst the farmers of the principles of hydraulics and the mode of taking levels. In this respect, however, a great change has taken place in the last few years by the introduction of science into agricultural operations; and the principles on which irrigation should be conducted are generally understood by all farmers making any pretensions to intelligence or scientific knowledge.

The great use of water-meadows is the advantage of having an early crop of grass in the spring for the breeding ewes and their lambs, by which they are usually fed down in March and April. They are then flooded, and shut up for a crop of hay in the summer. The after-math is fed off by cattle, or cut for feeding them in the byres. Sheep should never be turned into them in the autumn, it being sure to give them the rot. Whatever may be the cause of this, the fact itself is indisputable—that, whilst the grass of water-meadows is so fattening and healthful in the spring to sheep of all kinds, it is equally pernicious in the autumn when they are turned in to graze upon it. If it is intended to produce a crop of hay, the meadow should be shut up the first week in May. If this is put off later, even for a week, it is said that the quality of the hay will be entirely spoiled, being rendered soft, woolly, and unsubstantial, as in the case of after-math crops. Being shut up and flooded for some days, the grass afterwards will be ready for the scythe in five or six weeks. This being taken off, the meadow should be again flooded, when a third crop, either of hay or of grass for feeding off the ground or in the stall, is produced, the latter mode being the best and most economical for its consumption.

The produce of grass from water-meadows is very large. Mr. Stephens, in his "Book of the Farm," mentions a piece of ground belonging to Mr. Simpson, of Glenythan, in Aberdeenshire, which had never produced grass for the scythe until he caused it to be irrigated by a burn that ran through it; after which, in the first year (1814) it produced 119 cart-loads of grass, of 6 cwt. each; and in the second, 142 cart-loads, the quantity of land being 4 acres, 1 rood, 38 poles. Each load yielded 2 cwt. 104 lbs. of hay, so that the produce of this once barren piece of land was, in 1815, 495 stones of 22 lbs. to the (Scotch) stone; the value of which, at 6*d.* per stone, was £12 7*s.* 6*d.* per acre, or £52 17*s.* 6*d.* for the whole field, being £21 9*s.* 3*d.* more than the ground cost to convert it into a water-meadow.*

The Orchiston meadows in Wiltshire are well known for their extraordinary productiveness, the tithe having, it is said, been sold for five guineas an acre. Besides those counties we have named, Worcestershire, Dorsetshire, Hampshire, and Berkshire, have their water-meadows; and those at Lexham, in Norfolk, formed by Mr. Beck about the beginning of the present century, have been noted for their productiveness. Mr. Morton estimates that the entire breadth of land employed as water-meadows in England does not exceed 100,000 acres.† There is no question that an apprehension of interfering with the mill-races, and thus getting involved in a law-suit with the miller, deters many persons from thus employing the rivulets they possess on their farms.

The quality of the water to be employed in irrigation should be strictly attended to; for if it is chalybeate it is apt to do more harm than good. A naturally soft, and comparatively warm water, is the best adapted, and clear, rather than turbid or muddy. Those rivulets flowing over a calcareous soil are considered the best for the purpose, being generally quite clear, the calcareous matter being retained in it in a form imperceptible to the eye. It is just the reverse with arable land, which is benefited by being overflowed by turbid water, as in the case of the Nile in Egypt, and other rivers that overflow their banks in the spring. The Humber, in Lincolnshire, is also an instance in which the warp or sediment of the river has been made the means of rendering thousands of acres of peaty or sandy soils rich and productive, bringing in a rental of 50*s.* or 60*s.* per acre.

In forming water-meadows, the fall of the ground, and the relative position of the stream or spring to be employed, must be considered, for on this depends the feasibility of the work. If the subsoil is a clay or loam, it should be thorough drained, as a preliminary step, in order to prevent any portion of the irrigating water from being retained in the subsoil should it penetrate thereto, and then become otherwise stagnant. This would, in a great measure, neutralise the benefit of the irrigation, by the encouragement of coarse grass and rushes. The drains will, of course, obviate this, and by opening channels for the surplus water, lay the land dry, and encourage the growth of the finer kinds of meadow-grass. The drains should be from 3 to 4 feet deep, according to the level of the catchment or main drain. The common drain-tiles are the best and cheapest materials that can be employed for the purpose, and one inch diameter is a sufficient bore.

If the stream from which it is intended to draw the water has land belonging to another proprietor on one side, only half the water can be claimed for the purpose; but if both sides belong to the party, there can be no dispute about its appropriation; and

* "Book of the Farm," vol. ii. p. 679.

† "Encyclopædia of Agriculture," art., Water-meadows.

the same is the case if it arises from a spring on the farm, although it may be of benefit to another party after it leaves the estate on which it originates. It may be desirable to erect a dam across the stream in the case of a rivulet or a river, but regard must be had to the rights of other parties who may possess royalties over the waters, which would be injured by its erection. If the right to do it is disputed, and cannot be purchased, it will be better to seek a supply of water from the high lands abutting upon the meadows, rather than run the risk of a suit at law, which, even to the winner, is too frequently a losing game. River water, however, is best, if it can be obtained, on account of the organic matters held by it in solution, especially if it runs through a calcareous district. The fall need not be more than 1 foot in 100 yards; but this must extend to every part of the land to be irrigated, so that every drop of water may be kept in motion, and none suffered to remain stagnant. A spirit-level is absolutely necessary for the purpose of irrigating to the best advantage; and, where it can be done, the inequalities of the land should be adjusted in the first instance. It would, in fact, save a vast deal of after trouble, and render the work more perfect, to lay the meadow in regular ridges, slightly elevated in the centres, on which the water-courses should be formed, taking care to have them lie in the direction of the incline of the land. We have seen water-meadows formed on this principle which exhibited a perfectly uniform surface of rich verdure as early as February. This is termed bed-work irrigation, and it must be so conducted that the main drain receives the whole of the water after it has performed its work, and conveys it away, so as to prevent any stagnation. It will be readily perceived that this mode of irrigation must be the most perfect, if properly executed, because it makes provision for an uniform distribution of the water, and for its entire riddance when it has performed its mission. The width of the ridges must be regulated by the nature of the soil and the quantity of water at command. Where the soil is tenacious, and the water scanty, a 30-feet ridge is sufficient; while for a porous soil, and abundant supply of water, from 40 to 45 feet will not be too much. The crowns of the ridges should rise a foot above the furrows on each side. The channels or feeders on the top of the ridges should taper in width to the lower end. Thus, for a bed of 200 yards in length, the feeder should be 20 inches in width at its junction with the conductor, and 12 inches at the other extremity. As the water decreases as the overflow proceeds, the decrease in the width of the feeder enables it to continue filling it to the brim. The drains in the furrows, for conveying the waste water from the meadow into the main drain, should taper in the contrary direction, beginning with a narrow, and ending with a wide channel, where it delivers the water into the main drain. Obstructions should be placed at intervals both in the conductor and in the feeders, in order to prevent the water from flowing too fast, especially if the fall is rapid. If, however, the fall is moderate, and the irrigation properly conducted, these obstructions are not required to any great extent. Stones or pieces of turf are generally used for the purpose. The water should be let in from the river or brook by a sluice, and small sluices should also be placed in other parts of the conductor, so that any part of the meadow may be flooded, and alternate watering adopted when the waters are low.

In forming a bed-work water-meadow, if the land has previously been under the plough, it should undergo a thorough cleaning by a summer fallow, and thus prepared for the grass seeds in August, having been levelled both by the plough and harrow, and by the spade, where necessary, the spirit-level being in constant requisition. Lawson recommends the grasses mentioned below* as the most proper for a water-meadow, and in the proportions named. The perennial rye-grass will yield a good crop the first summer, whilst the other grasses are gaining vigour and filling the ground.

But if the proposed irrigation is to be conducted on land previously under grass, the turf should first be raised in square pieces, and laid on one side. The land should then be ridged and levelled with the plough and spade as in the previous case, and the turf then relaid and beaten firm, and a few of the best meadow-grass seeds sown over it, and the work will be complete, the conductors, feeders, and small drains, having been made at the same time with the ridging of the land.

The catch-work mode of irrigation is the invention of, or, at least, has been improved by, Mr. Bickford, and is styled "*the improved Devonshire system*," having been practised first in that county. It has the merit not only of being much cheaper than the bed-work system, but of having received the approval of the late Mr. Pusey and other eminent agriculturists, and it has been extended into other parts of the country by them. The following is Mr. Bickford's own description of the system as drawn up at his request by Mr. T. Barker :—

"*The Main Carrier* : — In commencing the construction of a water-meadow, a carriage-gutter is cut along the line of the highest ground. This main gutter is for the purpose of taking the water from the brook or other source from which it may be derived, in order to feed the smaller or irrigating gutters—in fact, it acts the part of a main artery. This main gutter need not be laid out by the level. A rapid inclination should be given to it, according to the nature of the ground and the quantity of water that can be made available. Where it can be had, a fall of 2 inches in a chain is convenient ; but, if need be, a less rapid fall will answer the purpose. The width of the main carriage-gutter should be 18 inches, and the depth from 6 inches to a foot. The dimensions, however, must in some measure be regulated by the quantity of water to be conveyed along it. The gutter diminishes in size as it approaches its termination, so that at last it runs out to nothing.

"Immediately below the carrier should be cut a set of small tapering gutters. The office of these tapering gutters is very important, as they secure the even apportionment

* The following seeds are recommended by Messrs. Lawson for lands in preparation for irrigation :—

Names of Grasses.	Light Soils.		Medium Soils.		Heavy Soils.	
	With a crop.	Without a crop.	With a crop	Without a crop.	With a crop.	Without a crop.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Agrostis stolonifera	1¾	2	2	2½	2½	2½
Alopicurus pratensis	1¾	2	2	2¼	2¼	2½
Fistuca loliacea	1	1½	2	2	2	2¼
„ pratensis	2	2½	2	2½	2	2½
„ elatior	1½	1½	2	2	2	2
Lolium italicum	7	9	7	9	7	9
„ perenne	10	12	10	12	10	12
Phalaris arundinacea	1	1	1½	2	2	2¼
Phleum pratense	2	2	2	2¼	2½	3
Poa fluitans	2	2½	2	2½	2	2½
„ aquatica	1	1	1	1	1	1
„ trivialis	2	2½	2½	3	3	3½
Lotus major	2	2	2	2	2	2
Trifolium hybridum	1	1	1	1	1	1
	36	42½	39	46	41¼	48

of the water over different sections of the field, adjusting the supply in the way of a self-acting valve. Sometimes the end of a carrier itself performs this office, and is tapered accordingly.

"*The Small Irrigators.*—A series of small gutters are cut below the main carrier (at different levels) in the same general direction, in order to catch the water as it overflows from the carriage-gutter through the small taper-gutters. The distance between these gutters greatly depends on the shape of the ground; where it is undulating and uneven more are required. These small gutters ought to be laid out quite level. I say quite level, subject, however, to a qualification to be named hereafter. The water, as it flows over the land, is collected in these small gutters, and as they are practically level, they again distribute the water evenly over the surface when they become filled; were it not for these small gutters, the water would get into little streams, and flow down along the hollows, instead of the ground being all equally covered, especially when the land has never been ploughed or levelled.

"I mentioned that the small gutters ought to be level; this, however, in practice, must not be carried out with mathematical correctness; in crossing any hollows, the gutters should be kept rather higher—say an inch in 33 feet run—or the water will gather in the hollows, and overflow too fast at these points. On passing along the projecting ground, on the other hand, the same difference should be made in the contrary direction, viz., an inch lower than the strict level, in order that *that* portion of the ground may receive its due share of the water. The exact rise or fall to be given can only be arrived at by experience. Any surplus sods that are taken out of the carriers, &c., as well as any turf produced by the removal of banks or heaps, should be placed in the largest holes and hollows, in order to make the surface more level: the sods should be trodden in, and if the water is not turned on injudiciously, they will soon bind together with the old turf. It is of great importance that the water should never be stagnant on any portion of the land, otherwise rushes and coarse grasses will grow, as they would do in the vicinity of springs and on wet undrained ground; an outlet gutter should be carried out of any such hollow (if filling it up would be too expensive) to the nearest level gutter below it. Care should be taken never to allow the water to remain very long in the same place. I have noticed that the grass is apt to turn white; this is a clear sign that something is wrong. The water should never stand still, and never be so deep that the tops of the grass cannot be seen above it. In fact, it is the sign of perfection of irrigation if you walk into a meadow under water, and find the fact by wetting your feet before you see the water.

"It is of quite as much importance to get the water off quickly as to get it on evenly. To effect this gutters are cut in the direction of the inclination of the ground, *i.e.* exactly in the same line along which the water would flow if left to itself to run; if the gutters take any other direction, swerving too much either to the right or left, they will cut off the water from some of the land on one side or the other. . . . When the land is being irrigated, these downward gutters have stops placed in them where to cross the level or watering gutters. Stops are also placed along the level gutters, when required, to confine the water to a particular width of land. The number of these depends on the quantity of water; when the supply of water is short, more are needed; it is easily seen, when walking over the meadow when the water is on, where more are required; nor does it give any trouble to place a piece of sod across the small gutter—it is done in a moment."

Such is the "Bickford system of irrigation;" the expense of which was estimated by the late Mr. Pusey not to exceed £2 per acre, including every item; and in some cases, when the ground was particularly favourable for the operation, it did not amount to much above £1 per acre. When we consider that the bed-work irrigation in Hampshire has in some cases cost from £15 to £20 per acre, and that the Bickford system, when carried out judiciously, is quite as effectual, there can be no question of the superiority of the latter, especially in the case of tenant farmers with small capitals, who are totally excluded from reaping the benefit of so expensive an improvement as the bed-work system.

The levels are taken by a simple instrument with two limbs 6 feet long, in the form of the letter A, the feet being kept 4 feet apart by a bar, in the centre of which is a mark or notch. A plumb-line is fixed at the apex, so that when the two feet stand on the same level the plumb-line crosses the notch. The operator places one of the feet on the ground, and turns the other about like the leg of a pair of compasses, until he sees, by the line crossing the notch, that the level is found. A mark is then made by a lad who accompanies the gutterer, by digging up a piece of the turf; and the operation is repeated; and so on, as long as a level can be found, when the operator stops, and begins another gutter. It is evident that, on this system, the line cannot be preserved in a straight course; but a skilful hand will be able to irrigate a whole field or meadow, however unlevel, by a judicious arrangement of the water-courses and the sluices; whilst the small expense it involves recommends it to the attention of the tenant farmers, as an admirable method of improving coarse pasture land, where water for the purpose can be obtained. Mr. Bickford, in his tract on the system, states, that an advanced rent of 40*s.* or 50*s.* per acre has freely been given for meadows treated on the Bickford plan by the landlord, and the results fully justify such an increase. It is the opinion of many persons that simple irrigation with the water of a river or brook is quite as efficient as sewage irrigation. This, however, can only be the case where the water is strongly charged with organic matters or with a solution of those mineral substances favourable to the growth of grasses, such as calcareous earths of all kinds, and those essential portions of animal and vegetable remains held in solution by the waters in passing over the land into the streams after heavy rains. When the district through which a river passes consists of siliceous sandstone only, the effect of irrigation by it is much less beneficial.

The practice of irrigation is of very ancient date, and originated in warm countries, as China, Egypt, Persia, &c. In Italy, too, especially in Lombardy, aqueducts have been constructed for the purpose of conveying water to the fields and pasture grounds, and irrigation has long been practised in that country. In Milan, which formerly constituted part of Lombardy, until it was erected into a duchy, all rivers and streams belong of right to the sovereign, who sells the waters to speculators, for the beneficial purposes of irrigation. It is sometimes measured out by the length of time a certain quantity of water is allowed to run upon the lands; and sometimes a stream of water passing through a tube or hole, of a certain diameter, from a canal, is sold or let at the highest price it will bring. The whole country is intersected with canals formed for the purpose of conveying water to the lands, and every new spring discovered becomes the origin of a new canal. Some of these works carry us back to the year 1037. There is certainly less occasion for this in more northern climates, and especially so moist a one as that of the British Isles; but the great and acknowledged improvement it effects on pasture lands of all descriptions ought to induce the enlightened English farmer to practise it; and yet we find that to this day, irrigation is confined to a very limited extent of country, it being estimated (as we have stated) that not more than 100,000 acres have been thus improved.

With regard to the proper time for commencing the operation of flooding the pastures, in the months of December and January, after the grass has been eaten down by cattle, and the channels cleansed and repaired, it should come into full operation. Sometimes, if the previous preparations admit of it, the water is laid on in November for three weeks, taking advantage of the floods from the heavy rains of autumn, which bring with them a large amount of sedimentary organic matters. After this first dose, the land should be laid dry for some days, to give time for those grasses which are likely to suffer from a longer continuance of flooding to recover themselves. The principal object in December and January is to shelter the land from the severe frosts which may be expected at that season, by covering it with water. It should, however, be laid dry every ten or fourteen days; and the flooding should always be discontinued when the meadow is covered with a coating of ice.

In the month of February, if the water be allowed to flow over the land many days without intermission, a white scum is produced,* which injures the grass. And on the other hand, if the water is wholly taken off, and the land exposed to the frost at night, the young succulent grass will be destroyed. To obviate these effects the Gloucestershire farmers take off the water by day, to prevent the scum from generating; and turn it on again at night, to guard against the frost.

By March the grass is generally long enough to afford ample pasturage, and the water should be withheld a week before the cattle or sheep are turned in, to give time for the land to become dry and firm. At first, hay should be given with the grass, to prevent scouring; but if the weather be dry, as it usually is during that month, this may cease after the first week or ten days. The highly nourishing quality of the grass of irrigated pastures and meadows is such that all animals fatten very fast upon it. The usual method is to give a fresh portion of the meadow every day or two by hurdling it off; but the system of stall-feeding is getting more and more into fashion, as being far more economical as to the consumption of grass, and better for the cattle than when they are at liberty to roam about and interfere with each other's feeding.

By the beginning of May the grass will usually be eaten close, when the water should be turned on again for a few days, and again shut off. If the weather is very dry, this may be repeated for a short time, just to moisten the roots of the grass. After which, by the middle or latter end of June, a good crop of hay will be produced, which, if not allowed to stand too long, will be equal to upland hay; but if it remains long, it will become coarse and hard, and not of much more value than straw. It should, in fact, be cut just before it is in full flower, when it contains in its joints all the saccharine juice, which afterwards is absorbed in the formation of the seeds, of which it forms the starch. This applies to all kinds of hay, and is too little attended to by agriculturists, who frequently allow their grasses to stand until the seeds are formed, and, sometimes, ripened, before they cut the crop. The seeds are, in that case, generally shed on the ground or in the stack, and the hay loses more than half its nutritive properties. The London hay-farmers are well aware of this, and generally cut their

* This white scum arises from incipient putrefaction of the roots of grass, and is a sure indication that the continuance of the water on the surface is destroying the grass—in fact, that it has already remained too long.

grass when it is in the most succulent state, and before the flower is well formed, which will account for the highly fragrant scent the hay-fields near the metropolis always give out.

In Ireland the reverse of this is practised, the farmers almost invariably allowing their grass to stand until the seeds are dead ripe; and when cut, it usually lies until every particle of sweetness is lost. The writer purchased hay for many years at the Dublin hay-market, and he never met with a single load that possessed any of that fragrant perfume for which English hay is noted. It is frequently also left in cocks in the field for months, exposed to the rain and wind; the reason alleged being, that the dampness of the climate will not admit of its being stacked until it has been thoroughly weathered. But surely there is a medium between leaving it so long exposed in the field without any protection, and stacking it hastily before it is properly made. It is to be hoped that the migration of Scotch and English farmers into Ireland may introduce a better mode of both cultivating grasses and hay-making. The writer once pointed out to an Irish farmer a field of grass which contained more may-weed and other useless plants than grasses. The farmer coolly observed that the weeds filled up the crop, "and sure it was betther than half a one."

Dr. E. Darwin, in his "*Phytologia*," makes the following just observations on this subject:—"This will appear of more importance to any one who attends to the difference of the pods or husks of peas or of kidney-beans, during the early state of the enclosed seeds, and again, after the seeds have become ripe. The pod or capsule is at first sweet and mucilaginous, so as to supply an agreeable and nutritious food; the latter of which, and sometimes the former, are eaten at our tables. Afterwards, as the seeds which are attached alternately to each side of the capsule, drink up, by their vegetable life, after impregnation, the saccharine and mucilaginous matters, there purposely deposited for them, the capsule itself becomes a mere fibrous membrane, not better than the straw of ripe grains above-mentioned."*

The advantages of forming water-meadows and irrigation are thus summed up by the same intelligent writer:—"First, not only the common meadow-grounds are enriched, but morassy ones are consolidated by the mud brought over them by the river water, or the calcareous sediment, and azotic or nitrogen air, from most spring-waters, during those seasons when grass does not naturally make much progress in its growth. Secondly, they are defended from frost by the flowing water, or by the ice when it is frozen; and thus, a much forwarder crop of grass is produced, as may frequently be seen over pieces of ground naturally moist; which look green in the spring some weeks before that on drier land in their vicinity. Third, the ground is rendered more easily penetrable by the the roots of grass, both by its being kept softer, and also from its being seldomer frozen below the surface in the vernal months. Fourth, this early crop may be eaten off by cattle or sheep; and a new flooding for a short time will forward the growth of it, so as to produce a good crop of hay. Fifth—after the hay is removed, another flooding, for a short time, ensures a luxuriant growth of autumnal grass, or after-math."†

It is remarked by Parkinson, that artificial watering of meadows is a most profitable improvement; it robs no dunghill, but raises one for the benefit of other lands: for if a farmer can water ten acres of land, cut the grass, and use it either in stall or fold-

* "*Phytologia*; or, the Philosophy of Agriculture," p. 275. † Ibid., p. 278.

feeding, he might keep forty beasts; and by working the manure made by them into a compost, and applying that compost to other lands, he might either have a great deal more hay for winter, or feed more cattle in summer. It has been estimated that there are at least 2,000 acres of meadow-land in every county in England and Wales capable of being converted into water-meadows. This appears a very small proportion of the land of the country, and does not agree with the fact of 100,000 acres being already under irrigation in a few counties only; whilst, on the other hand, there are hundreds of brooks and rivers, with large tracts of meadow and pasture land lying below them, capable of irrigation, but of which no use whatever is made in their improvement. There is no question that there are thousands of acres, of little worth in their present state, in every county in the kingdom, that would yield twenty times their present products by the application of a comparatively trifling outlay, and be a source of wealth to the proprietors; and there are few such lands in this country but have a river, a rivulet, or a strong spring, in their immediate vicinity, and that might be made available for irrigation, upon the catch-work system.

The kinds of land most amenable to improvement by irrigation are the gravelly or sandy, the boggy or peaty, and the clay soils. The gravelly soils are those which are the least expense, and pay the best for irrigation. They do not require draining, the water, filtering through them into the main outlet, drains them naturally, allowing of no stagnation. Being, also, naturally warm, the vegetation receives immediate benefit from the operation, and makes a rapid progress. The peaty soils are generally found on the banks of rivers, and in their natural state produce only coarse grass and rushes. They require a preliminary draining, to as great a depth as the fall of the river will admit, in order to lay them dry and provide an escapement for the water that soaks into them in the operation. If the rushes are mown before the water is turned on, the roots will decay and disappear, as well as the coarse grasses, and an abundance of useful, if not first-rate, grass or hay will then be obtained at all times, except in the three winter months. The strong wet clay soils are the most difficult to deal with, on account of their tenacity in retaining the water, and their lying generally on a dead level, which prevents the water from flowing freely over them. Drainage, too, which is absolutely necessary for them, is a difficult operation, and ought to be coupled with sub-soiling; and both these processes would pay well for the trouble and expense. Such soils, thus treated and subjected to the irrigation of a river from which abundance of water can be thrown over them, will yield heavy crops of grass and hay of the best quality.

Rivulets and springs are considered by some persons as more eligible for irrigation than large rivers, on account of the greater facility they offer for conducting the water over the land. If, however, they possess any chalybeate properties, which is frequently the case, they are unfit for the purpose. If a brook passes through a well-cultivated country, and receives in its passage the drainings from the land, it will impart the richness it thus acquires to the meadow over which it is conducted. The organic matters carried down by the lesser streams at certain periods of the year, when the land floods prevail, are very considerable; and if deposited on the adjacent meadows, prove highly fertilising. Springs also, that rise from a calcareous soil, are so, although the water may be perfectly clear.

Water-meadows, if properly attended to, never decline in value, but, on the contrary, improve in quality continually from year to year. Provided no water is allowed to stagnate upon them, the coarse grasses and rushes disappear, and the finer kinds take their place, and cover the ground with a rich sward of bright green verdure. If the soil is a peat-bog it soon assumes a sound and solid appearance and texture, so as to admit of cattle being fed upon it. A rich soil forms on the surface, which increases in depth every season, without any manure being applied. Forsyth mentions, amongst other cases, that of a meadow of seven acres, the whole crop of grass from which was sold for £2. It was converted into a water-meadow by two skilful men, and from that time it was let at £3 per acre annual rent. In short, there is no soil so poor, or so sterile, but it would be improved and rendered productive by a proper application of irrigation.

We have stated that clear water, rather than turbid, is the most efficacious. This is Morton's opinion; but the practice of the Gloucestershire farmers is against this, their experience having convinced them that the more turbid, feculent, and replete with putrescent matter the water is, the more rich and fertilising it proves. "Such turbid water is both meat and drink to the land, and, by the unctuous sediment and mud it deposits, the soil is amazingly improved and enriched." At the same time there are springs proceeding from calcareous or gravelly subsoils of a warm thermal temperature, which, although perfectly clear, produce surprising effects upon grass land irrigated by them. The beneficial influence of springs, therefore, in a great measure depends upon the quality of the water proceeding from them; but that of rivers and brooks, on the quantity of organic matters held in solution by the water and deposited on the land.

With regard to the land proper to be converted into water-meadows, we may state, generally, that wherever a piece of land, whether pasture or arable, lies convenient for irrigation, it will pay far more profit thus than in any other mode of cultivation. This is capable of easy demonstration; for if, without the application of any of the manure of the farm, the quantity of feed upon a given extent of the land can be doubled, which it undoubtedly may be by irrigation, double the number of sheep or cattle can be kept on that land, and double the quantity of manure raised for the rest of the farm; and thus the whole farm receives the benefit of the irrigating process just to the extent to which it is carried.

We shall conclude this section by quoting the following observations of an intelligent writer of the beginning of the present century:—"When we consider the great extent to which irrigation might be carried in many parts of this country, together with the fertility—that is to say, the riches—to be derived from the proper use of so cheap an ingredient as cold water, which is at present allowed to run to waste in such abundance, it is worthy of consideration how far the Legislature would not be justified in adopting some public regulation for giving facility to undertakings of this sort." The last quoted author (Arthur Young), in travelling through Lombardy, remarks, that "the power of effecting the great works in irrigation which are visible over the whole country depends very much on the law, which supposes the right and the property of all rivers to be vested in the king; consequently all canals taken from them are bought of him; and this ensures another regulation, which is the power of carrying the water, when bought, at the pleasure of those who buy it, where they think fit. They cannot, however, cut across any man's ground without paying him for the land and for the drainage; but the law does this by regulations known to every one, and no individual is allowed a negative upon a measure which is for the general good. The purchasers of water from the king are usually considerable landowners, or communities that have lands wanting water; and it is of no consequence at what distance these lands may be from the river whence the water is taken, as they have a right to conduct it where they choose, provided they do not cut through a garden or pleasure-ground. . . . . The benefit of water is so great and so well understood, that nobody ever thinks of making objections; and in case their lands are not already watered, it is no small advantage to have a new canal brought through them, as they have the opportunity of buying water of the proprietors. It is sold per hour per week, and even half an hour, and down to a quarter. The common price of an hour per week, for ever, is 1,500 livres."

Could not the new Drainage Acts, by another "amendment," be made to embrace a system of irrigation on the same principle of financial arrangement as that of draining? That it would be a national as well as a private benefit, there could be no question, and doubtless great numbers of proprietors would avail themselves of it, to convert their now wild and barren tracts of rough meadow, yielding nothing but coarse grass and rushes, into profitable pasture. The high price of all kinds of animal food, whether in the shape of butchers' meat or of dairy produce, is, one would think, a sufficient inducement to increase as much as possible the quantity of food for cattle, as the most ready means of increasing our supply of the animals themselves.

SECTION XI.

ON SOILS.

We have already defined soil to be the medium by means of which the farmer is enabled to obtain his produce.* It is, in fact, the neutral agent coming between the manure and the seed, which are the materials of production; soil being only rendered fertile by the application of the first, and yielding fruit only by that of the second.

Soils are enriched by the vegetables they produce, provided no part is removed, because they derive a large portion of their nourishment from the atmosphere and water; consequently their increase is greater than the amount of nourishment they derive from the soil would account for. When, therefore, they die, they return more to the soil than they receive from it. We see this process in the case of the *lichen*, which constitutes the first vegetable product of the granitic rock. When it dies it leaves a modicum of vegetable earthy matter, which, after a series of years, accumulates by the repetition of the process, and a soil is formed. Nor is this all. The vegetable earth thus formed decomposes and eats into the rock itself, and thus adds to the earthy matters; so that in process of time, a sufficient amount is collected to afford support to vegetables of a larger growth.

Soils are considered rich or poor in proportion to the amount of organic matter they contain. Limiting the application of this assumption to individual soils, it is strictly correct. Thus a clay, or a loam, or a gravel, are each enriched by the addition of

* See page 211.

organic matter. But, as a general principle, that those soils which contain the greatest amount of organic matter are the most productive, is not true; because it is found that some of the best wheat-bearing soils do not contain more than $3\frac{1}{2}$ per cent. of organic matters; whilst others, containing 10 or 12 per cent., will not grow wheat at all, or, at least, will yield a much inferior crop. Dr. Anderson, in a paper in the *Scottish Journal of Agriculture*, shows, that in the best wheat-lands of Scotland the per centage of organic matter ranges from 3 to 10 per cent. in the upper, and from 3 to 6 per cent. in the subsoil. Certain it is, however, that without a proportion of such matter, the produce will be very poor; and, on the other hand, a kindly soil will always gratefully repay for the manure judiciously bestowed upon it.

That soils are caused by the disintegration of rocks we have showed before, and this is effected by the action of the oxygen of the atmosphere, which forms compounds called oxides with mineral substances to which it has an affinity. Those rocks, for instance, containing iron, are powerfully acted upon, and by the formation of oxides, break up the texture of the mass, which then crumbles to pieces. Carbonic acid also, descending with the rain, has an affinity for some minerals which are disintegrated by it; such as limestone, sandstone, basalt, clay, &c. On these, in different modes, the carbonic acid exercises a powerful influence. Carbonate of lime it dissolves, and where it has opportunity, as in caverns shut out from the atmosphere, it forms stalactites. Felspar and granite are dissolved by carbonic acid, and form, with the silicates they contain, carbonate of potash or soda and silicate of alumina, or clay. The roots also of plants, by insinuating themselves into the small crevices of the rocks, act like wedges; and by keeping the surfaces of these crevices constantly moist, widen them by a gradual decay, and thus hasten the decomposition of the mass. As to the time required to complete the process of the formation of a soil under such circumstances, there is no evidence to judge by; but that this is the way in which it is effected there cannot be a doubt.

But besides these chemical agencies, which are for ever at work in the demolition of rocks, there are others of a mechanical nature, which assist in the work of forming soils from the *débris*. The force of gravitation, acting upon a rock undermined by chemical decay, brings down large portions into the valleys, where they crumble under atmospheric influence, and are dispersed by the water. Water itself acts mechanically, by filling up the crevices in the rocks; and when the frost comes, it expands and bursts them into fragments. Floods carry the *débris* into the rivers, while the attrition to which they are subjected in the passage reduces them to a comminuted state, so that they are deposited by the waters on the banks, and form those alluvial soils which we usually find in such situations.

When to all these causes is added the accumulation of vegetable matter which has been going on for ages with increasing volume, and the animal remains which, in life, harboured amongst the foliage, and in death left their frail but innumerable skeletons to increase the quantity, we may form a correct idea of the nature of soils. In estuaries and tidal rivers these latter constitute a large portion of the soil found on the shores washed by the tide at high water; the immense masses of *infusoria* that are thus deposited with mud by tidal rivers account for the fertility of the soils thus formed.

In an agricultural point of view, a soil is considered by the husbandman to be that portion of earth which comes under the dominion of the plough; what is below that is the *subsoil*, which, until of late years, did not engage much attention as a source of production, or the object of cultivation. Of soils, then, in the sense here stated, there are three distinct classes—the heavy, the medium, and the light—and these are represented by clay, lime, and sands, in all their several varieties. Whatever comes between these is composed of a union of the three in a greater or less proportion, or of the decayed remains of animal and vegetable bodies. Each of these classes comprises a certain number of subordinate kinds, and they meet in what is technically termed "a mixed soil," in which the three elements are blended in a proportion so favourable both to cultivation and to vegetation, as to render it peculiarly desirable and valuable, and requiring little or no mechanical alteration in its texture.

The *light soils* comprise the sands and the gravels; the *medium soils* are the calcareous, the marls, and the chalks; the *heavy soils* are the stiff clays and the clay loams.

A pure sandy soil is not a profitable one to cultivate. Many tracts of such are to be found in Norfolk, and Suffolk, and other parts of the kingdom. Incredible pains and expense have been bestowed upon some of these to render them productive, and not without success. As much as 150 loads of clay per acre have been laid on some farms, by which means they have been rendered capable of growing any kind of crop. But such is the loose texture of some of these tracts, that in a high wind in dry weather the sand will drift like snow,* and both soil and sand are blown into heaps. When well mixed with clay or marl, sandy soils are easy to cultivate, and good crops of both cereal and root produce are yielded by them. In their natural state, these soils contain fully 80 per cent. of pure sand.

The gravelly soils are frequently found mixed with loam, in which case good farming will render them very fertile. It was such soils that occupied the attention of Arthur Young, before whose time they were usually let at from 2*s*. 6*d*. to 5*s*. per acre, and are now worth from 25*s*. to 30*s*. They are very easy to cultivate at any time, the only obstacle being the great number of stones usually found on the surface, which, the farmers assert, are continually growing and increasing in numbers. Be this as it may, there seems to be no end to them, for although they are clean picked up and carried off to mend the roads, the next turn of the plough will bring them up apparently as numerous as ever. These gravels require a mixture of marl or clay to give them consistency. They frequently overlie a bed of marl at the depth of from 10 to 20 feet. All root crops thrive on them when well cultivated.

The calcareous soils contain a large proportion of lime. Such constitute a considerable part of the South Downs of Sussex and Hampshire, which are mostly laid out in sheep-walks, for which they are peculiarly adapted, on account of their not retaining the rain-water on their surface. When well cultivated, they produce heavy crops of grain, without any mechanical alteration of their texture.

The marly soils usually contain from 5 to 20 per cent. of lime, and from 20 to 50 per cent. of a fine clay or brick-earth. They are good soils to cultivate. In some specimens the marl is mixed with sand instead of clay. Most of them contain large proportions of carbonate of lime.

A pure clay soil is the most difficult of any to manage, and requires greater vigilance in the husbandman to avail himself of a favourable time to work it. In very wet and

* The writer once saw on a farm at Ringland, near Norwich, the subsoil of part of a field laid bare, the whole of the soil being drifted by the wind, like snow, into a long ridge as high as the fences.

very dry weather it is unapproachable by the plough. It absorbs and retains moisture longer than any other, and when not drained is cold and ungenial. More, however, has been learned of late years of the nature of clay soils than was formerly known; and it has been found that, under a judicious system of management, the once unfertile and stubborn clays have been rendered the most productive, especially of wheat, for which, under favourable circumstances, they are peculiarly adapted. Their mechanical structure requires the reverse treatment from the sands and gravels, and is much improved by an admixture of any light earth. But drainage and subsoiling are the best remedies for the evils of a clay farm.

The loamy soil is composed of one half clay and the other half of siliceous sand, lime, and vegetable matter. Some loams are heavier than others, but they are all easily cultivated, and very productive. Stephens defines a loam to consist of "any kind of earth containing a *sensible admixture of decomposed vegetable matter.*" We confess we cannot see the propriety of this description, or of altering in any way the ancient definition. The word *loam* is *English*. It was made for, and applied to, a certain description of soil composed of clay and sand, or clay and marl, and as either of these preponderated, it was a sandy, or a clayey, or a marly loam, without any reference to the vegetable element, on which Stephens lays so much stress, but which, in point of fact, has nothing whatever to do with the *nature* of the soil. Every farmer knows well what he means when he speaks of a sandy or a clayey loam; and he knows also that such a soil is the most profitable of any, and the most easy to cultivate. A sand with any proportion of vegetable matter, but without the clayey element, would not constitute a loam, and *vice versâ.*

It will be seen that we confine the term "soil" strictly to mineral or unperishing substances as the bases of cultivation. Those which are purely, or nearly so, the product of decayed vegetable matter, are accidental accumulations of the elements of production, which require the union with mineral substances, or a soil, to render them available. A peaty soil is of this description, being a mass of decayed vegetable matter; but a peaty soil will not of itself be productive. *Humus,* also, is an earthy substance arising from the decay of vegetables; but *humus* is proved to be unproductive until mixed with mineral matters, when its beneficial action commences. Speaking of this latter substance, Sir Robert Kane makes the following remarks:—

"Before passing from the consideration of the composition of soils, it is necessary to add to this account of their constituents, as derived from the rocks by which they are formed, some notice of the peculiar organic matter which all fertile soils contain, and to the functions of which I shall have to recur after some time. After the death of a plant, its elements, yielding to the force of their chemical affinities, enter into new arrangements, and by a series of progressive alterations are finally converted into a dark brown material, termed popularly, vegetable mould, and by chemists, *humus,* or *ulmine.* When perfectly pure this substance contains no nitrogen, and consists of, as prepared:—

	From Wood.	From Sugar.
Carbon	72·7	65·65
Hydrogen	6·1	4·28
Oxygen	21·2	30·07
	100·0	100·00

Such a material is totally destitute of power on vegetation, and the confounding of it with substances which are produced in the natural rotting of the remains of plants in the soil has been very prejudicial to the progress of agricultural chemistry."*

Although a peaty earth is unproductive, or only so in proportion to the quantity of mineral matters it contains, when brought into contact with soils of almost any description, it is found to be eminently fertile. A good dressing of marl or clay will render it so; and, on the other hand, peat applied to a sandy soil, as a top dressing, has produced a permanently beneficial effect, although it did not improve the *texture* of the land. Its endurance, however, must depend upon the large amount of organic matter it contains beyond what two or three crops could take up, there being but little besides vegetable substances in peat. The following is the elementary composition of different kinds of peat in Ireland according to Sir R. Kane:—

	Turf from Cappoge.	Turf from Kilbeggan.	Turf from Kilbaina.
Carbon	51·05	61·04	51·13
Hydrogen	6·85	6·67	6·33
Oxygen	39·55	30·46	34·48
Ashes	2·55	1·83	8·06
	100·00	100·00	100·00

According to the above analysis, peat, like *humus*, contains little or no nitrogen, in lieu of which it yields, on distillation, a small quantity of acid from acetic acid, but not enough to make it an object of manufacture.†

A remarkable case of improvement of a peat moss in Scotland is recorded in Forsyth's work on agriculture, which has been the means of reclaiming large tracts of that kind of land. On a part of a moss on the estate of Mr. Smith, of Swinridge Muir, near Beith, a quantity of lime was accidentally thrown, in consequence of the bemiring of the cart in which it was being conveyed. This was spread over the surface of the surrounding moss, another portion of which had been pared and burned, whilst a third had had nothing done to it. The crops on the two first, to Mr. Smith's surprise, were equally good; whilst that which had been neither burned nor limed produced nothing; and even that which was pared and burned produced so much sorrel as almost to choke the oats, the limed part being entirely free from that plant. Mr. Smith took the hint, and by the same means, after draining off the water, reclaimed all the moss in his own occupation; and also supplied his tenants with limestone gratis, and small coal at prime cost, to enable them to secure the portion they held of the moss. By this liberal and judicious conduct the whole of the moss on his estate was brought under profitable cultivation.‡ The quantity of lime applied varied from 180 to 480 Winchester bushels per acre, and it required to be laid on the previous summer or autumn, in order that it might be more intimately combined and mixed with the peat, so as to form a homogeneous mass. The lime should always be applied in its most caustic state, and also while the moss is moist.

Garden-ground, from its more careful cultivation and more frequent manuring, is formed of a soil distinct from any other, being chiefly a mass of black vegetable mould,

* "Industrial Resources, &c.," p. 255.

† Ibid., p. 34. Some of the turf bogs of Ireland are 40 feet in depth. The lower part of the bed is much more dark in colour and dense in texture than that near the surface, and is consequently more valuable for fuel. The ashes of the surface peat amount to not more than 1½ per cent., whilst some of the lowest contain 19 per cent.

‡ "Theory and Practice of Agriculture," vol. i. p. 410.

capable of sustaining vegetation in its highest state of perfection. If it were possible for the farms of England to be brought to the high degree of cultivation which the garden exhibits, there would be scarcely any limits to the amount of produce. Many of the market-gardeners on a large scale do thus test the powers of the soil, and, by a profuse and unsparing outlay, render it capable of producing two and three crops in one season. It consists, in fact, of a mass of vegetable mould, with a sufficiency of the mineral element for the purpose of giving it solidity. But it requires constantly renewed applications of manure to sustain its fertility; and any relaxation, either in the proper cultivation or enrichment would very soon be manifest in the diminution of produce. The quantity of land of this character is so limited as scarcely to constitute a class of soil, and its vegetable character allies it rather with peat and *humus* than with the genuine mineral soils which constitute the bases of agricultural operations.

The case of these vegetable moulds shows that a very small proportion of mineral matter is sufficient to impart fertility to them, but that without that proportion they are unproductive. Analysis further proves that the mineral part of plants, although composed of many substances, amounts to only a minimum of their bulk. Thus wheat, the ashes of which constitute not more than from 1·67 to 1·73 per cent. of its weight, comprises in them nine elementary matters of a mineral character, the proportion of each of which must necessarily be exceedingly small.

Morton states that any soil containing more than 6 per cent. of organic matter, whatever else its composition may be, is called a vegetable mould; and that soils of the most opposite physical characters are thus grouped together in the class of vegetable moulds. This seems a very small proportion of those elements constituting the bulk of vegetation to give a character to a soil. In the analysed specimens he gives, the proportions range from 10·90 to 90·44 per cent.; and what is remarkable, and accords with what has just been stated, the latter was a sterile bog, whilst the first was a rich soil on the banks of the Weser in Germany, liable to be flooded by that river.

Soils with abundance of animal and vegetable matter in them absorb heat in much greater quantity than those composed wholly of minerals. Sir Humphrey Davy found that a rich black mould exposed to the sun, increased in temperature in one hour from 65° to 88°; whilst a chalk soil exposed to the same heat was raised only to 69° in the same time. On the other hand, when the mould was placed in the shade, with a temperature of 62°, it lost in half an hour 15°, whilst the chalk, under the same circumstances, lost only 4°. Other experiments made by the same eminent chemist served to confirm the correctness of this fact, which is probably accounted for partly by the looser texture of the black mould, and partly by its colour. It is well known that the earth is not heated by the sun *by radiation*, but by contact with the atmospheric air, which penetrates the interstices of the soil, and by receiving it also in contact with the surface, which first acquires heat, and then communicates it by contact with the soil beneath. The colour also, being dark, absorbs the heat of the atmosphere more rapidly and more copiously. The same causes which *raise* the temperature of the vegetable mould so rapidly also serve to *lower* it; its loose texture admits the cold air, or rather allows the escape of the warmth it had acquired.

The colour of soils has, indeed, a material influence upon vegetation, which is always more rapid in its growth upon a dark than upon a light soil; this is to be ascribed to its greater absorption of heat by day and of the warm dew by night. The latter, taking the place of the heated atmosphere imbibed during the day, sustains to a certain extent its own warmth acquired from the heated air. An experiment of Schübler showed that a sand of the common colour, under the sun's influence, indicated a temperature of 112½°; a black sand, 123½°; and a white sand, 110°, giving a difference of 13½° in favour of the black sand. All close soils, although they absorb heat more slowly, also give it out in the same proportion. A sand cools more slowly than a clay, and this latter, than vegetable earth. Stephens considers that the power of soils of retaining heat depends in a great measure on their specific gravity, and gives the following comparative scale :—

	Specific gravity.		Specific gravity.
Siliceous sand	2·653	Pipe clay	2·440
Sandy clay	2·601	Arable soil	2·401
Loamy clay	2·581	Garden mould	2·332
Brick earth	2·560	Humus	1·370
Pure grey clay	2·533		

On the other hand, the capacity of soils of retaining water to saturation is in the adverse proportion with their specific gravity, according to the same authority :—

	Lbs. per cubic foot.		Lbs. per cubic foot.
Siliceous sand	27·3	Pipe clay	47·4
Sandy clay	38·8	Arable soil	48·4
Loamy clay	41·4	Garden mould	48·8
Brick clay	45·4	Humus	50·1
Pure grey clay	48·3		

"Where we meet with a great water-holding power extending 90°, we may reckon, with great probability, on an abundant admixture of organic matter."†

The absorption of oxygen by soils appears also to be in proportion to their specific gravity. The following result of experiments by Schübler, and given in Stephens' work, is decisive on this point :—

Grains.		Cubic inches.	
1,000	Siliceous sand in a wet state absorbed	0·24	From 15 cubic inches of atmospheric air, containing 21 per cent. of oxygen.‡
,,	Sandy clay	1·39	
,,	Loamy clay	1·65	
,,	Brick clay	2·04	
,,	Grey pure clay	2·29	
,,	Garden mould	2·60	
,,	Arable soil	2·43	
,,	Humus	3·04	

Of the physical properties of soils, Schübler thus sums up the results of his experiments :—"In the examination of soils, the determination of their power of containing water, and of their weight, consistency, and colours, in connection with their chemical analyses, will, in the majority of cases, be sufficient to enable us to conclude, with great probability, as to their remaining physical properties. The more an earth weighs the greater also is its power of retaining heat; the darker its colour, and the smaller its power of containing water, the more quickly and strongly will it be heated by the sun's rays; the greater its power of containing water, the more has it, in general, the power also of absorbing moisture, when in a dry, and oxygen when in a damp state, from the atmosphere; and the slower it usually is to become dry, especially when endued with a high degree of consistency; lastly, the greater the power of containing water, and the greater the consistency of a soil, the

* "Book of the Farm," vol. i. p. 94. † Ibid., p. 95. ‡ Ibid.

colder and wetter, of course, will that soil be, as well as the stiffer to work, either in a wet or dry state."*

The necessity of ascertaining the composition of a soil, especially one that is unproductive, or only weakly productive, is much better understood now than fifty years ago. By a careful analysis, the farmer can discover the precise elements in which it is deficient, and thus be enabled to apply the manure or mineral material required to render it fertile. In fact, there is no soil so incorrigible as not to be capable of fertilisation. Thus, a soil containing salts of iron, which render it sterile, may be recovered by the application of quicklime, which converts the sulphate of iron into a valuable manure. An excess of calcareous matter in a soil may be ameliorated by the application of sand or clay. Light, sandy soils, are improved permanently by a dressing of peat, and *vice versâ*, after the water is drained off from the bog. Some soils are deficient in vegetable matter, and require a supply in the manure. Others have an excess of vegetable matter, in which case an increase of mineral manure is useful, or a portion of the soil may be burned. The excess is quite as injurious to vegetation as the deficiency. This is seen in the peat mosses, which will not support valuable plants without a due mixture of mineral materials of one kind or other. Some peat mosses are acid, and on such a dressing of calcareous matter is indispensable. If they are covered with coarse grass and rushes, the best plan is paring and burning, the ashes being then spread over the surface. The performing of these operations must always be preceded by drainage; for, unless, the water is drawn off, no manure or mineral application will be fully available.

SECTION XII.

SEED.

It is now generally agreed amongst agriculturists, that the selection of seed, whether of wheat or any other plant, is a matter of importance, and that it should be made with reference to the fineness of the quality, its unmixed character, and its freedom from the seeds of weeds and smut. The grain should be plump, clean, and healthy, and as free from a mixture of species as possible. This latter quality is of more consequence to the ultimate success of the crop than most farmers are aware of. Le Couteur, whose opinion and experiments we have already referred to, has shown that, in the case of wheat, unless this point is attended to, the produce will ripen at different times, whilst the several sorts will vary in yield several bushels per acre. He therefore recommends not only a selection of the best sample *to the eye*, but also that it should be picked over by the hand of an experienced person, so as to ensure a oneness of species that cannot be obtained in any other way. The experiment of a Suffolk farmer mentioned below† is a

* "Book of the Farm," p. 96.

† A farmer at Bradfield, in Suffolk, in passing through his wheat-fields, perceived a great difference in the colour of the blossoms, the wheat being then in full flower. At first he thought this was ascribable to accident; but upon further consideration he came to the conclusion that it indicated a differeuce in the species. He therefore marked eight or ten

case in point. If the farmers generally would pay more attention to this subject, they would find not only that their crops would ripen simultaneously, but that, by selecting the most productive types, their produce would be greatly increased.

The years 1795 and 1796 were signalised by an extensive failure of the wheat crop; and, as we could import but little from the Continent, and none from America, a severe scarcity was the result. With the view of alleviating in some measure the pressure of this calamity, Sir Joseph Banks instituted a series of experiments with the mildewed wheat, which he planted in a hot-bed; and finding that the thin seed vegetated as well as the full-bodied grain, he jumped at once to the conclusion that, by sowing the thinnest instead of the best wheat, a large amount of sustenance would be saved, which would in some measure relieve the country. We have already shown the absurdity of this opinion, and its opposition to all analogy in the vegetable and animal kingdoms, as well as to reason and common sense. The principles on which it was founded were, 1st, That one-tenth of the starch contained in a grain of wheat is sufficient to sustain the young plant in life until it can shift for itself; 2nd, That one-fourth less seed-corn is necessary; and, 3rd, as the most important reason, that the shrivelled corn was not fit for making bread. It is to be observed that Sir Joseph's experiments were made on a hot bed, and the seeds consequently having two wet nurses instead of one, the weakling embryo had a double chance of life. To carry out the practice upon the farm is quite another thing, and would most probably prove a display of the equivocal economy which reverses the proverb, and "gives a herring to catch a sprat."*

We have already, in treating of the different species of *cerealia*, anticipated to a certain extent the subject of this section. We may, however, be allowed to recommend some general rules for choosing seed-corn or grain of whatever kind. Select, then, the fullest-bodied, clearest, and thinnest-skinned seed, as that which exhibits the best type of the species. Obtain it from a place south rather than north of the farm on which it is to be sown, it having been found that seed sent from north to south does not thrive so well as that from south to north. All seeds vegetate better if kept in the straw until wanted, especially the cereal seeds. We have referred to the question of sowing over-year wheat instead of that of the new crop (see p. 472). Millers always prefer "old wheat" instead of new, because it produces flour of greater strength. Wheat is a semi-biennial plant, and it is seldom that the season is sufficiently warm fully to mature its vegetative power in time for the autumnal sowing. The proof of this is in the fact we have alleged of the superiority of over-year wheat for mealing purposes. It proves that a change must take place in the grain, independent of the dryness; and the question is, whether this change has not improved its character for seed-corn as well as for making flour.

The quantity of seed to put into the ground is a debatable question, which we have already discussed in regard to wheat, in speaking of Hallett's system (p. 473); and the plan of raising a new stock of wheat from a single grain is also referred to. It is admitted by our best agriculturists that by the common practice a great amount of seed is worse than wasted; for the crop itself is less abundant with over-seeding, nor is the

varieties of colour, from white to dark red, and at harvest carefully gathered the ears, and kept them separately labelled. The produce he planted in his garden, and found that they produced plants with precisely similar characteristics with the seed sown. Three only of these were preserved as worthy of attention, the difference in the yield being, by a correct estimation, as much as eight bushels per acre.

* See p. 482.

quality so good. Mr. Stephens has made an ingenious calculation of the loss of grain by the practice of sowing a large quantity of seed. "Wheat," says he, "of 63 lbs. per bushel, gives 87 of its seeds to the drachm, or 1,403,136 to the bushel avoirdupois weight. Now, three bushels of seed are sown per acre, or 4,209,408 grains of wheat. Suppose each grain produces a stem, and every stem an ear containing the common quantity of 32 grains, we have 134,701,056 grains, or 1,548,288 drachms, which, divided again by the number of drachms (256) to the pound, gives 6,048 lbs., or 96 bushels. But the heaviest crop in Scotland seldom exceeds 64 bushels the acre, so that 32 bushels to the acre, or 33 per cent., of the seed is lost on the best crop, and 58 per cent. on the ordinary crop of 40 bushels.

"The waste of barley may be thus estimated:—Chevalier barley, at 57 lbs. per bushel, and 75 grains to the drachm, gives 1,094,400 grains to the bushel. Four bushels of seed are sown to the acre, which gives 4,377,600 grains to the acre; and taking one stem to each seed, and one ear to each stem, and the number of grains in the ear at 32, the produce should be 128 bushels. But the best crop in Scotland does not exceed 60 bushels, which gives a loss of 53 per cent. on the best, and 62½ on an ordinary crop of 48 bushels.

"In like manner the loss upon oats may be estimated. The potato oat of 47 lbs. per bushel, and 134 grains to the drachm, gives 1,612,288 grains per bushel; and as 6 bushels of oats are sown to the acre, it gives 9,673,728 grains of seed per acre; and taking one stem and one ear to each grain, and 44 grains to each ear, the produce will be 264 bushels per acre. But the largest crop in Scotland I know of is 114 bushels to the acre, and a poor one is 36 bushels. Thus, more than one-half on the good land, and six-sevenths on the poor land, is lost."*

Mr. Stephens takes another view of the case, as follows :—

Wheat	4,209,408	grains per acre gives	869	seeds per square yard.
Barley	4,377,600	,,	904	,,
Oats	9,673,728	,,	1998	,,

The absurdity of crowding such numbers of seeds into so small a space must strike even the most obtuse intellect; and yet the practice is continued. Take the wheat, for example: a grain of wheat, if it has room, will produce a plant that will cover a foot of ground on a moderate computation, and produce from 30 to 40 ears. What, then, must be the effect of planting nearly 100 grains in the same space, with the certainty that not more than one-half or two-thirds of it will vegetate, and that the crowded state of those which survive renders them weak and sickly, and accessible to every disease to which the plant is subject? But the case of the oats is still more preposterous. This grain will tiller and spread as much as the wheat. We have now before us the produce of one plant amounting to 5,000 grains, rubbed out of between 40 and 50 ears, and which occupied about 1 foot of ground. Six bushels of seed per acre allows 222 grains to the foot or three to every 2 square inches; and the consequence, according to Mr. Stephens, a practical farmer, is, that six-sevenths of the seed is thrown away.

* A more expeditious way of reckoning these estimates is to multiply the number of grains in the ear by the number of bushels sown, and the result will give the number of bushels per acre; thus—

Number of grains of wheat in each ear	. . . .	32 × 3 bushels	=	96 bushels.
,, Barley in ,,	. . . .	32 × 4 ,,	=	128 ,,
,, Oats in ,,	. . . .	44 × 6 ,,	=	264 ,,

We are aware that the plea for this waste is, that the husbandman must allow for the depredations of the rooks and other enemies, who attack the fields as soon as they are sown. This would be a fair plea if he could persuade the marauders to confine themselves to taking the supernumerary grains *only*, leaving just the number to each square yard that the nature of the soil is able to bear. But the rooks and other birds are burglars rather than tax-gatherers, and having never studied arithmetic or the doctrines of *meum* and *tuum*, pay no regard to the welfare of their friend the farmer, who thus sows a bushel or two per acre for their express delectation; nor to his remonstrances against their ingratitude, except they are in the shape of powder and shot. In fact, they rather like to clear away as they go on, if not disturbed, and leave ugly blanks in the field, rather than a regular plant.

It is also the practice to sow more seed on poor land than on good, which, when we consider the nature of things, appears another absurdity. Why a poor soil is supposed capable of sustaining a larger number of plants than a good one it is not easy to conceive. The plea for this, too, we know to be, that whereas on the good land the plants will tiller more, and therefore require more room, on the poor land they come up with single stems, and consequently may stand closer. But the reason why the plants on poor land shoot only single stems is, because either the soil does not contain nourishment to enable them to develop themselves, or that they are too crowded to be allowed to do so. Most probably both these causes operate; but, at any rate, the result proves the absurdity of the practice as well as of the argument in favour of it. A clergyman was once visiting a poor woman who had just been confined with twins, and who expressed her fears that she should find it difficult to support the increase to her large family. "Never fear," said his reverence; "depend upon it, my good woman, Providence never sends mouths without sending the victuals at the same time." "That's true, your reverence," replied the woman; "but, you see, he sends the mouths to *me*, and the victuals to *you*." Now this is the case with the farmer; he sends the mouths to the poor, and the food to the good soil, and the consequence we see in the miserable return obtained. "In poor land," says a Norfolk farmer, "sow thin, or your crop will be worth little. Farmers who do not reason on the matter will be of a different opinion, but the fact is indisputable." The Norfolk farmers are well acquainted with the nature and treatment of poor land.

The preparation of seed is a subject which has occupied the attention of farmers in all ages, especially seed-wheat. The liability of this grain to the disease of smut is notorious and various dressings have been recommended for destroying the seeds of this fungus, which may happen to be attached to the grain. A pickle of salt and water, strong enough to swim an egg, is a favourite panacea with some; afterwards liming the wheat to make it fit for sowing. But where farm-yard manure has been laid on for the crop, this or any other dressing is of little use, as the straw of which the dung is made contains the seeds. "In the summer of last year" (1796), says Varlo, "I saw a piece of wheat belonging to one Mr. Clarke, a farmer, near Bungay, in Suffolk, which contained about seven acres, four of which were the smuttiest I had ever seen. Upon an average, it was computed that the third part was smutty, but the remaining three acres were very clear of smut. This was a curiosity which brought many people to see it, and staggered many who pretended to be connoisseurs on this mysterious point.

"I told Clarke that I believed I could guess the reason. 'So can I,' says a by-standing farmer; 'which is, he did not pickle his seed; for I always steep mine,' says he, 'in strong salt and water, and lime it; by which means I never am troubled with this malady.'

"'Yes,' answered Clarke, 'I pickled the seed all alike in salt and water, strong enough to swim an egg, and limed it till I brought it to a consistence proper for sowing, and sowed it all within the space of three days, which proved dry weather: the field, likewise, was summer fallowed, and all got ploughing alike.' I told him that I imagined he threw the disease into the ground by his manure; for that I apprehended he dunged the smutty part, and either left the other undunged, or manured it with some sort of compost. 'Upon my word,' answered Clarke, 'that is just the case; for I dunged the smutty part, but the other I manured with a black mud or sludge I raised out of the bottom of a pond and other ditches.' . . . . . The above is a convincing proof that the disease came into the ground by the way of the dung, as in both the land, seeds, and management, were in other respects alike."*

A preparation of arsenic is a favourite dressing with others. An ounce of the mineral to 2 gallons of water is a sufficient quantity. The arsenic should be pounded perfectly fine, and boiled in the water before it is used. The seed should be steeped in it until saturated, and then dried by sifting quicklime over it. Arsenic, however, is a dangerous material to deal with, and requires more caution than farm servants, or even farmers themselves, usually exercise. We knew an instance in which the arsenical liquid was thrown over the grass in a pasture where several cows were feeding. Five of these, feeding on the spot where it was thrown, were taken ill, and four of them died before the farrier arrived. To the fifth he administered *a pound of small shot*, which saved its life, by neutralising the effect of the arsenic.

Some years since, a chemist at Norwich advertised a remedy for the smut, which he offered to communicate to the farmers when he had procured a certain number of subscribers at one guinea each. The father of the writer was one who gave his name and guinea. The remedy was, to wash the seed-wheat perfectly clean in a running stream, and then to lime it in the usual way.

This was considered by the subscribers generally as a take-in; but, on reflection, the writer's father tried it on some very smutty wheat, on a small scale, and, to his satisfaction, found it perfectly successful. From that time he never used any other preparation for his seed-wheat, nor was he afterwards troubled with the smut in the produce. We would recommend our agricultural readers to try the same experiment also, on a small scale at first, as, if successful, it may save them much trouble and some expense in preparing other washes.

Stale chamber-ley is used by many persons. It should be allowed to stand in a tub until fermentation has arisen to a degree to admit of the escape of ammonia strong enough to make the eyes smart. It may then be used diluted with water thus:—Remove the tub into a barn; sweep the floor clean; have two baskets ready, and a second tub, *empty*. Fill the basket with wheat, and dip it into the ley so low as to cover the top of it: let it remain until the ley has penetrated the whole mass; lift up the basket, and let the liquid run from it; then place the basket on a drainer over the empty tub, where it may remain until the next basketful is ready. Empty the drained wheat on the floor, and riddle over it some slaked caustic lime. When a

* Varlo's "New System of Husbandry," vol. ii. p. 3.

sufficient quantity is thus dressed, it should be all turned over and mixed until it presents an uniform appearance.

In all these cases the lime is essentially useful, both to dry the wheat, and to assist in cleansing it. It will also be of some use in promoting the vegetation of the seed, by the warmth it imparts to the modicum of soil surrounding the seed. This latter effect may be of no small benefit, especially in an unkind season, when it is desirable to have the wheat appear above ground as soon as possible. When the wheat has become thoroughly mixed, it should at once be put into sacks, and taken to the field where it is to be sown. If allowed to remain any length of time in a body, the strength of the ley would destroy the vegetative faculty of the seed.

A more modern, and probably a more effectual, preparation for dressing seed-wheat, is made from a solution of sulphate of copper, or blue vitriol. Dissolve $1\frac{1}{2}$ lb. of the vitriol in 2 gallons of hot water. Allow it to cool, and then mix it intimately with 1 quarter of wheat, for which it is a sufficient dose. The wheat should be spread upon a floor, 6 inches thick, and the pickle sprinkled equally over it with a common watering-pot with a rose on it; and then shovel it up over and over, so that the wheat may thoroughly absorb all the moisture. There is no danger in using this pickle, even if the quantity of vitriol be doubled. In this respect, also, it is far superior to every other kind of dressing, which are (some of them, at least) highly dangerous in careless or unskilful hands. Wheat dressed with vitriol does not require liming, which is another advantage, the lime being injurious to the hands of the sower, although in other respects it is useful to the seed.

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