MORTON'S HAND BOOKS of the FARM

No VI.

EQUIPMENT

BY

SEVERAL WRITERS.

VINTON & Co. LTD. 9, NEW BRIDGE STREET.

LONDON

HANDBOOK OF THE FARM SERIES.

EDITED BY J. CHALMERS MORTON,

EDITOR OF THE "AGRICULTURAL CYCLOPÆDIA;" THE "AGRICULTURAL GAZETTE;
THE "FARMER'S CALENDAR;" THE "FARMER'S ALMANAC;"
"HANDBOOK OF THE DAIRY "FARM LABOURER," ETC.

MORTON'S HANDBOOKS OF THE FARM.

No. VI.

EQUIPMENT.

BY

WM. BURNESS, J. C. MORTON, AND
GILBERT MURRAY.

SECOND EDITION.

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THE present Volume is one of a series discussing the Cultivation of the Farm, its Live Stock, and its Cultivated Plants, Farm and Estate Equipment, Dairying, and Farm Labour, the Chemistry of Agriculture, and the Processes of Animal and Vegetable Life. Among the writers who have been engaged on them are Messrs. T. BOWICK, W. BURNESS, G. MURRAY, the late W. T. CARRINGTON, the Rev. G. GILBERT, Messrs. JAMES LONG, J. HILL, SANDERS SPENCER, and J. C. MORTON, Professors G. T. BROWN, J. WORTLEY-AXE, and J. SCOTT, the late Professor JAMES BUCKMAN, Dr. MAXWELL T. MASTERS, F.R.S., and Mr. R. WARINGTON, F.C.S.

PREFACE.

It is plain that so large a subject as is included in the title of this volume, requires for its complete treatment many more pages than can be devoted to it here. The reader will however find that the wants, both of the farm and of the estate, are discussed in considerable detail. The implements of the farm are enumerated and to some extent described. The requirements of the farm in horse-power, labour, and live-stock, are illustrated by a number of examples, of which the lessons are carefully extracted. The amount of capital required is also the subject of consideration; and examples are given of the kind of calculations on this subject which any intending occupant of a farm must make before the offer of a rent is determined on.

And to the equipment of the estate, also, attention is directed in several of the concluding chapters. The Roads, the Fences, the Water-supply, and the Homestead, thus all come under review; and there is a concluding discussion of the Landlord's Capital, as it may be called, which is invested in the necessary equipment of his property before the best can be made of the natural and inherent capabilities of the land.

Mr. W. Burness has contributed the Chapter and Appendix on Agricultural Implements; and the chapters relating to Estate Equipment have been for the most part written by Mr. Gilbert Murray.

The reader will find that further details, costs, specifications, and data for calculations with reference to many of these subjects, are given in an Appendix.

J. C. M.

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THE

EQUIPMENT OF THE FARM.

INTRODUCTION.

THE equipment of the farm, in so far as that is the work of its owner, includes the provision of buildings in which the tenant, his labourers, and his livestock, implements, and produce may be accommodated, and various operations connected with all of them carried on—the provision also of a water supply for both house and homestead—the division of the farm into fields by fences, and the access to each by roads. All these are subjects connected rather with the estate than with the farm, but as to which the title under which we are writing will justify some amount of expectation by the reader. These subjects will therefore be to some extent discussed. But the main purpose of this handbook is to enumerate and specify the requirements of the cultivator as the tenant, not the owner of his farm. He requires a certain amount of capital with which to turn the land he hires to profitable account. And this capital he invests in implements for the due cultivation of his land—in horse-power, by which the implements are to be worked—in livestock, by which much of his produce will be consumed and converted into marketable commodities—in purchased additions to the home-grown food, on which

for the most part they are fed—in manures for adding to the fertility of the soil—in seeds for the crops which it is to yield—in labour, paid for and directed to all these various ends.

The equipment of the farm, as we propose to discuss it, will thus include first the implements of the farm, and next the number of stock of various kinds to be kept on it. These are the subjects of our first two chapters; the latter being treated, not theoretically, but by a statement of the actual facts in several enumerated examples. The quantity of farm capital required for all these purposes is the subject of a final chapter. And the various equipments provided by the landlord also form the subject of separate sections of the book.

CHAPTER I.

THE IMPLEMENTS OF THE FARM.

Drainage implements.—Brick and tile machines.—Cultivating implements.—Ploughs, Steam tillage.—Harrows, Rollers.—Sowing machines.—Horse hoes.—Harvesting machines, Reapers, Horse-rakes.—Barn machinery, Threshing, Winnowing and Dressing machines.—Chaff-cutters, corn and cake crushers, turnip cutters and pulpers.—Steaming apparatus.—Hay and corn drying machines.—Dairy implements.—Live stock furniture.—Carts, waggons.—Prime movers.

THESE include several machines proper to be enumerated, which, however, are not necessarily required by every farmer. Several of the tools, or rather the machines, which are required only occasionally, are hired; steam ploughs and cultivating machines, draining machines, even threshing machines are not necessarily owned by every farmer. He can obtain the use of them, and of hands accustomed to work them, from men or companies who let them out on hire. Steam engines for working these machines are also to be had on hire. And although in the case of large occupations it is not advisable to be dependent in this way on hired machinery, yet for smaller farms the capital which would be invested in the purchase of them may be well dispensed with. The quantity of machinery found on most large farms is indeed rendered necessary now by the difficulty of obtaining labourers, and by the increasing cost of wages; but the enormous difference between the present day and the circumstances of fifty

years ago—when plough, harrow, grubber, roller, cart and waggon, and fork and flail were almost all the implements of the farm—inevitable as much of it is, is really more than can be justified. And if we here go through the long list of tools now used, it must not be supposed that all of them are considered always necessary.

Drainage Implements.—A draining plough for steam power* consists of a vertical coulter carrying a horizontal mole suspended from the beam frame of a four-wheeled carriage. It is hauled by wire rope from the winding drum of a steam engine, and the mole is raised or lowered by screw gear as it travels, according to the unevenness of the surface. When used as a mole plough two pits are first dug, one at each headland: the coulter is then lowered into the one and hauled to the other, the mole leaving an open waterway behind. When pipes are used, pits are dug at intervals: a wire rope is hooked on to the heel of the mole, and pipes strung on it are drawn through the distance between two pits; the wire rope is withdrawn, leaving the pipes behind, and another length of pipes is strung on. Depth 2 to 3 feet. For very steep inclines, and in subsoils liable to wash away, mole drains are unsuitable.

Hand draining tools are made in sets. A complete set for clay, loam, and gravelly soils includes common spade and top graft spade for all soils, a 20-inch middle graft tool, 15-inch bottom graft, flat and round bottom push scoops, flat and round bottom draw scoops, a pipe-laying tool and collar-laying tool, a reel with 100 yards of line, three levelling staves with T heads, a rod 8 feet long and graduated, so as to enable the workmen to know the depth

* Fowler (Leeds) improved by Eddington.

of the drain; a cross staff measure and spirit level combined; and poles for setting off drains.

Brick, Tile, and Pipe Machines are used for making draining pipes. A steam-driven machine, consisting of two pairs of rollers, crushes, pugs, and expresses the clay through the dies in a continuous stream—and the bricks, tiles, or pipes may be placed in the drying sheds without handling. The clay requires less weathering than when hand power is employed, and is often wheeled in barrows or railway trucks direct from the pit to the machine. From the clay being thus better ground, and made, it is expressed through the dies in a drier state, and hence is sooner ready for the kiln. Indeed, green bricks may go direct to the kiln, being dried with the waste heat of the cooling and burning bricks. Roofing tiles and draining pipes are similarly made. In large works kilns are built in several compartments—one for burning, one for cooling, one for emptying, and another for filling. There is a common chimney, and any of the fire flues can be shut off or on as required.

Cultivating Implements.—The *plough* consists essentially of a coulter for cutting the land side of the furrow slice, a share for cutting its lower surface from the subsoil, and a mould board for turning the slice thus detached, on its edges, thus inverting it and laying it against the last slice cut. These parts are connected in a frame including beam and handles above and side plate and slade below. We do not propose to occupy space with describing it in detail; it will suffice to point out the great variety now in use. Ploughs are of different kinds—as paring, ordinary,

skim, trench, and subsoil ploughs, single, double, and multiple furrow ploughs, swing and wheel ploughs, one-way or turnwrest, and balance ploughs. And there are ploughs with friction wheels instead of slades, ploughs guided by steerage wheels, and ploughs guided by a pole. It is worthy of note that the ancient British, Roman, Greek, and the modern Indian and Chinese ploughs are all constructed on the turnwrest principle, and that the Kentish turnwrest now in use is simply an improvement on the old Saxon. Upwards of 1000 patents for ploughs are filed in the Patent Office; and, as each, on an average, includes several claims, the total amounts to several thousand improvements of the different parts.

For light soils frames carrying two or more ploughs are now constructed. The plough invented by Thos. Pirie, Aberdeenshire, may be described as an example. It is supported on wheels, the sole and side plates of the ploughs being dispensed with. The coulters and mould-boards are joined to an angular frame, and by means of adjusting screws can be set at various distances apart for any required breadth of furrow. The wheels are also joined to the frame by moveable levers; and by means of set screws the plough can be raised or lowered and guided without stopping the horses. The axle of the leading wheel is attached to a lever, with which the ploughman can raise it and set it inwards or outwards as may be desired. The leading wheel runs in the bottom of the previously cut furrow, whilst a wheel on the opposite side of the plough supports the land side. A hind, or rear, wheel is attached to a moveable mould-board, and the position of this wheel and the leading wheels regulates the depth of the furrow slice. Short mould-boards are now preferred to long ones for inverting

the furrow slice, as they leave a rougher and better surface for covering the seed.

The ordinary *cultivator or grubber* is a five or seven-tined tool. The teeth are uniformly arranged in a frame, which is carried on wheels, and this being raised or lowered enables the tines or teeth to enter the land, in which they are dragged at depths varying from 5 to 9 inches, in equidistant paths, thus stirring the whole mass of the soil. Here, too, there is great variety of construction, the several forms varying in the shape and arrangement of the teeth and in the provisions for raising or lowering them. They are also constructed somewhat differently for horse and steam power draught.

The practice of smashing up land by horse and steam cultivators, instead of systematic ploughing, has greatly increased, and the tines and shares of horse and steam cultivators resemble each other in principle.

There are five systems of *steam culture* in use, viz., (1) the double-engine system—two traction engines, one on each headland, with implement between: (2) the single-engine system—a traction engine with winding drums on one headland, and a self-moving anchor opposite; (3) the roundabout system—a stationary engine and windlass, with two self-moving anchors, the rope going round the field; (4) the light rope system (Fisken's)—a manilla rope going round the field, supported by rope-porters, taken into snatchblocks at the corners, and driven by the fly-wheel of a stationary portable engine: and by going round pullies on self-moving windlasses, one on each headland, the implement is hauled to and fro between them. At the engine there are pulleys for keeping the manilla rope at the proper degree of tension; (5) double engine system

with two implements between engines on opposite headlands. It is plain that this is a mere catalogue of the several methods of steam culture in operation. We make no attempt at description or advocacy. Nor can we find room here for any account of the advantages which have attended the adoption of steam cultivation.

Harrows—frames several feet wide and long, carrying equidistant teeth eight to ten inches long—are used for breaking the surface clods after the plough or cultivator, or for bringing clods to the surface to be smashed by the roller. They are also required to detach weeds from land which has been stirred, bringing them to the surface to be destroyed; also for covering seed after it has been sown either by the hand or drill. They are now almost exclusively made of iron, the beams being of a zig-zag form, two, three, or four beams to one harrow; two, three, four, five, or six harrows to one whippletree or set; five or six tines in each beam. Heavy drag harrows may have chisel-shaped, or duck-footed tines; and some are in principle light cultivators with self-lifting wheels. There are also circular harrows that turn on a central axis slightly inclined from a vertical position, so that the tines sink deeper on one side than the other, causing them to rotate on being hauled forward. Chain harrows, constructed as a coarse coat of mail, are composed of plain, circular, or polygonal rings, toothed rings, and tripods—the latter connected by rings or links, the teeth being longer on one side than on the other, so that either surface of the harrow can be used as the nature of the land or meadow requires. They are serviceable for merely surface action, as when seeds require to be lightly covered, or when manure requires to be spread on grass land. Harrows for steam power are

dragged from two whipple-trees suspended from a beam, with a pair of steerage wheels and a seat for the driver at each end. The tines are so formed at the foot of each as to work either way as they go to and fro.

Rollers are of iron or wood, or hollow cylinders to be filled with water or sand. They are either made in pairs on a common axle for turning, or in one short length. To permit of back and forward rotation in turning, so as not to injure plants, a number of short cylinders may be placed on a common axle. Drill pressers are so made that they can be set nearer to or further from each other on their axle, to suit the breadth of the furrow slices, 2, or more, which they compress. Drill rolls, intended to press the ridgelets in which potatoes have been planted, or on which turnips or mangels have been sown, have a concave periphery, as of two cones on one axis with their bases outwards. Clodcrushers are composed of numbers of narrow-toothed cylindrical rings, so centred on the axle that they all break the clods below, but clear each other of any earth that adheres to them as they rise from the ground rotating above the axle. Norwegian harrows, in which two or three parallel spiked rollers are framed together so as to touch one another's teeth on being revolved, are of the nature of clodcrushers, and ought to be so designated, for, from their cylindrical action, they neither harrow nor cultivate. In point of construction they are improvements on the old spiked rollers.

Seed and Manure Drills, and Distributors.—The merit of the drill consists in its uniform discharge of the seed and manure by different coulters, and the proper depth at which both are deposited. The seed and manure thus being placed must also be protected from wind and rain during the process.

There are many plans of discharging seed, viz., by cups, cam barrels, chains, cylinder boxes, alternate teeth and brushes, screw discs, and the Anglo-American drill with force feed. Of these, cups are preferred, provided they are properly made; but at the Bedford trials (1874) the difference between two coulters in their delivery of seed was in some cases equivalent to 1 bush. per acre. The cups should be equal in size, all made to a common standard. The seed also requires to be of uniform quality and regularly fed into the seed box. Another point is that the bearings of the seed box and delivery should be made adjustable for uphill and downhill working, and for going along a hill side; and the box should be so partitioned as to keep a supply of seed to the cups equally on the upper as the lower side. For hard soils, a greater pressure on the coulters is required than is generally available, whilst on soft soils the reverse is often experienced. Telescopic seed and manure conductors, and flexible and other tubes, with ball-and-socket-joints, exclude rain and wind. Guano and phosphatic manures are very liable to paste by the action of the stirrers and discharging barrels in the manure-box, unless they are largely mixed with dry, well-burned ashes. Water drills for liquid manure act by cups or buckets on the periphery of a disc. Sets on either side dip into the liquid in the tank, and bring up small quantities which they discharge into hoppers at the top; and from the hoppers the liquid is conducted in tubes to the coulters. In some the cups are bolted to the wheel; in others they are cast with the wheel. In Chandler's the liquid is raised by buckets on endless chains.

Hand machines for sowing small seeds broadcast are long and slender boxes carried on a wheel-barrow, in which

a shaft carrying brushes or screw discs over the delivery holes is made to revolve (and so push out the seed), by means of toothed or chain gearing connected with the supporting wheel of the barrow. In potato drills the tubers are placed in a hopper, out of which they pass by a slide (regulated to suit the size) on to a sparred incline which feeds them into cups forming an endless chain. These by passing over a pulley discharge potato after potato into a spout, down which they are dropped into a furrow opened by a ridge plough. Two small mouldboards follow and cover the tubers in each row.

Horse Hoes have a two-fold function to perform—cutting weeds and loosening the soil between the rows of drilled crops. Hoes for corn crops have sometimes a seed barrel attached to them for sowing small seeds, as rye-grass and clover. For controlling the hoes in this case the hoe frame is independent of, but hangs from, the main frame that carries the wheels and shafts. The two wheels should have each an adjustable axle to slide out and in, so as to permit their being set wider or closer to suit the drills to be hoed. The wheels are as far apart as those of the drill by which the corn was sown, and the same number of rows are hoed together as were sown together. The levers should be fixed alternately to two cross bars, one in front of the other. The levers can thus be of equal length, a pair for each drill, the one carrying a right-hand hoe and the other a left-hand one. The weights upon the levers have thus an equal pressure, and the distance between the levers, laterally on the cross bars and longitudinally between the right and left-hand hoes can be adjusted so as to effect a perfect clearance. Some hoes are in the form of

the share of a ridging plough, others in that of a common share; but the general form is a horizontal blade bent back at an angle from the upright stem, so as to clean itself as it is drawn forward, the length of the blades corresponding to the distance between the rows.

The increased area of root crops now grown has given rise to a greater variety of drills and horse hoes than formerly, but the principle of construction is nearly the same. Hoes for drill cultivation are made for two rows at a time, but one-row implements are generally preferred. They are in the nature of a plough—having handles and beam, with one or two supporting wheels in front. They carry three or four tines, the leading one being in the beam and the others in two expanding wings. The front hoe is always of a triangular form, cutting on both sides. The wing hoes cut only on one side, with straight or curved blades. A small harrow may be attached behind; and, by means of a chain and lever, lifted when it gets full of weeds. Instead of hoes the implement may carry grubber tines, skim coulters; or the expanding wings may be removed, and the body of a ridging plough put on the beam. But general purpose drills and hoes are not so popular as they once were, single implements being found to do the work better and cheaper in the end. There is also a revolving horse hoe for thinning turnips—a circular edge, revolving obliquely to its route, with, however, gaps in its continuity, so that the row which would have been wholly cleared by it, is left in bunches, and may afterwards be singled by the hand.

Hand hoes are made of different sizes for different crops. They should be made of the best steel, so as to clean themselves in being drawn forward, and keep themselves sharp.

A set should fit a common handle. Weeding clips, and spuds, and weed extractors, are used for cutting thistles in crops and pastures. Docks should be pulled up by extractors, together with all other weeds that can be uprooted.

Haymaking Machines, Horse Rakes, Loaders, and Stackers.—The first patent in England for a hay-making machine of rotating forks for lifting and tossing the grass lying in swathes from the scythe, was granted to Mr. R. Salmon, Woburn, Beds, engineer to His Grace the Duke of Bedford, 1814. Since then upwards of 50 patents have been granted for improvements, of which four peculiarities of construction require description.

Generally they are rotating cylindrical frames, driven rapidly on a horizontal axis, and furnished with teeth, which toss the grass or swathe over which they are drawn. These fork-barrels are now preferably made in three sets—from wheel to wheel along the axis—and the sets are placed zig-zag, for the purpose of equalising the action of the forks and preventing clogging. The height of the forks from the ground, the different speeds, and the change in the direction of revolution from back to forward action are regulated without stopping. When the tine barrels rotate in the direction the horse moves, throwing the grass over the machine, it is termed forward action, and when they rotate in the opposite direction, lifting the grass behind, it is termed back action. In back-action haymakers, the tines are nearly straight, and adjustable as to pitch. There is no tendency to clog. In combined back-and-forward hay-makers, the pitch of the tines is adjustable, so that in the forward overhead action they can be set to suit light or heavy crops; and the same for backward action. In hooded haymakers, a light sheet-iron hood

extends back over the axle of the wheels with an expanded mouth, so as to permit of the grass being thrown a little upwards behind the machine, the better to spread it over the ground. This greatly prevents clogging; but if the crop is ripe the grass seed is liable to be threshed out against the hood.

Horse Rakes are now made to load and discharge themselves, thus permitting the driver either to ride upon, or walk behind the machine. There are several plans for effecting this. A break may be put upon the wheels by a foot tread, so as to prevent it rotating; and then the pull of the horse, the wheel acting as a lever, raises the tines, the pitch of which is adjustable (Howard); or the tines work in a rocking frame, and by a foot tread the driver can rock this frame and thus unload his rake at pleasure.

Drag rakes hauled by a strap over the shoulder, have steel teeth—the rake head, stay bars, and handle being made of wood. Light hand rakes are made wholly of wood. Gathering forks for windrowing rye-grass and clover have three steel prongs for going under the swathe, with a vertical one for pushing the swathe forward. Hand pitchforks are of different sizes, the prongs being of the best steel and handles of ash or some light tough wood.

Horse pitchforks for unloading carts and waggons in the stackyard are now provided after various designs.

Hay-loaders have long been used in America. A traveller band of rakes, like a straw elevator, raises the hay, discharging it on to a cart or waggon behind, at the side, or in front. They have not hitherto been adopted here.

Harvesting Machines.—The *mowing machines* of different makers, although differing in detail, have a close

resemblance to each other in the general principle of construction. The best have iron frames (so as to preserve the bearings in truthful working positions) on two road wheels, with the finger bar in a line with the main axle, and the crankshaft is as low as practicable, purposely that the thrust and pull may be equal. The cutter bar should be adjustable for regulating the length of the stubble; and it should fold up. Spur gear is preferable to bevel gear, especially for quick speeds; and the teeth should be external or open, to prevent clogging. There should be two speeds to suit different crops, and clutch gear should be used for throwing into and out of gear. All these adjustments should be under the control of the driver in his seat, and without stopping his team. The bearings should be self-lubricating, and protected from dust. But instead of the cutter-bar being in a line with the wheels, it is yet more frequently either in front or in the rear.

The knife is composed of what are technically termed sections riveted to the cutter bar. The sections are of various forms, and are either of an acute or obtuse angle, the two sides of the angle having a smooth cutting edge like a chisel. The edges of the fingers against which the sections make a shear cut are made of steel, and the fingers are made of wrought iron, malleable cast iron, or wrought iron and steel.

A *combined mower and reaper* with manual side or back delivery, is simply a mower, with a platform, grain wheel, and divider, the track-clearer being removed. With side delivery, a quadrant platform is required; for back delivery, a sparred tipping platform is used, the stubble, when the drop takes place, assisting to discharge the gavel. Automatic back delivery machines are also made.

Self-raker reapers are now made with controllable rakes, so as to make the sheaves of any size required at the pleasure of the driver. They have one driving wheel and a grain wheel, the platform and finger bar being between. The data given as to mowers apply to self-rakers. There are three plans of controlling the rakes. The first and second are nearly alike, the third is different in principle. In the first, all the rake-arms are independent. Four rakes are a good number, but three, four, five, or six may be used. Normally all the rakes sweep the platform, leaving a broken swathe behind; but by means of a foot-tread and connecting gear the driver can convert the whole into mere beaters for bending the crop in on the machine, or he can retain every second, third, or fourth rake to throw off a sheaf, the others acting as mere beaters.

Sheaf-binding harvesters are superseding self-rakers, the sheaf being bound with twine. They are made in two forms, viz., high platform and low platform machines. In the former the grain is reeled on to the platform by a reel, and carried over the wheel by an elevator on to the binder platform, where it is bound by twine and discharged at the side. In the latter the binder platform is a continuation of the reel platform in the rear of the supporting wheel. In another plan a binder-platform is attached to a self-raker. There are several plans of tying the knot, known as Fisken's, Burgess', Woods', and Appleby's.

Barn Machinery.—*Threshing machines* are either fixed or portable. The former work in the barn. The latter is shifted from stack to stack in the stackyard; and from one stack-yard to another in the case of a contractor's machine.

Fixed threshing machines are driven by water, wind, horse-power, and steam; portable machines by steam only.

Portable threshing machines are made of wood or iron framing, trussed wood framing being preferred, and are mounted on four wood or iron travelling wheels. Their threshing drums are made of iron, but those with tough ash beaters and steel beater plates are preferred. The concaves are made wholly of iron. The drum is fed from above, and should have a guard, or safety feeding board, to prevent accident in feeding. From the drum the threshed grain and straw is thrown on to the shaker, of which there are two kinds, namely, the single or double crank tossing-riddles, the common description, and the rotary shaker (Ransomes'), which consists of a series of transverse drums, each armed with three curved teeth, which revolve and clean each other, and pass the straw on to the end. In both cases the corn and cavings fall through to the caving riddle, the straw being tossed to the straw elevator beyond, by which it is stacked. Special drums are made for threshing wheat, beans, rape, clover.

In the first dressing apparatus attached to the threshing machine, the cavings, chaff, sticks, stones, weed seeds, and sand are separated from the corn, which is next elevated to the barley awner and smutter by a blast or cup elevator. From the awner and smutter the corn passes on to the second dressing apparatus, which consists of a series of riddles, with blast, which separate from the corn the refuse produced in the previous operation, the refuse being delivered below by a spout, the corn passing on to a rotary screen, which sorts it into three qualities, each being spouted into its own sack. Where the chaff is used for fodder it is cleaned and bagged by the machine, and where

the straw requires to be bruised, this is also done by the machine before it is stacked or stored away. In Messrs. Clayton and Shuttleworth's machine the bruising apparatus consists of a series of concaves and rapidly revolving drums, armed with cutting blades and bruising teeth, between which the straw passes. In Messrs Ransomes' the straw from the rotary spiked drums falls into a drum and concave armed with knives, which cut it up into 1½-inch chaff. The chaff then falls into a concave below, the drum of which is armed with blunt teeth, which throws it out macerated and fit for cattle food.

In detail there is considerable diversity in the construction of threshing machines and mode of attaching them to steam engines. The above involves the general principles. Exhaust fans for removing and bagging the chaff have long been in use, and are now preferred to blast fans in threshing machines.

Winnowing-machines and Screens.—The improvements recently made in finishing threshing machines have reduced the demand for separate dressing machines, fanners, and blowers, but they will always be required in barns and granaries. In principle of construction they resemble the second dressing apparatus of the threshing machine already described.

Straw Elevators and stackers consist of a four-wheel carriage, carrying an inclined trough, which can be raised to a perpendicular height of from 20 to 30 feet. Endless chain-rakes work in this trough, raising the straw, hay, or sheaves, and delivering them on to the stack. They may be driven from the threshing machine or by separate horse gear, or they may be combined with the threshing machine.

Corn Screens are connected with winnowing machines, either oscillating sieves of the proper mesh with a certain incline given to the surface enabling the discharge of the larger grain; or revolving wire cylinders with a sloping axle, into the upper end of which the bulk is delivered, and from the lower end the head corn is discharged, while dust and small seeds escape in the descent.

Clover and seed shellers are generally portable. The shelling barrel, the drum and beaters, being wholly made of iron, is placed under the dressing apparatus, and to which the shelled seed from the barrel is raised by elevators. The clean seed is delivered into sacks, and a side spout conveys the shivers away from the chaff.

The different bushel and other measures, hand riddles, sieves, scoops, weighing machines, and sack barrows, do not require comment.

Food Preparing Machines.—*Chaffcutters.*—Where all the straw is cut into chaff, it is best done directly from the threshing machine, the cut chaff being carried to the different stores by "travellers." Maynard has added a yealming machine to his chaff engine—delivering the straw combed out from the threshing-machine ready for the chaff-cutter. But when hay is cut along with the straw for cattle food, the work of chaffcutting is done separately. In this case, if there is not water power, it is generally better to have a separate engine from that used in threshing for driving all cattle-food-preparing machinery.

Corn Grinding and kibbling machines of the ordinary kind consist of French burr, and steel, mills. The former are made two ways—1, horizontal runner and bed,—and 2, vertical runner and bed. Steel mills for grinding are

either made with a conical runner in a horizontal or vertical case, and fluted cylinders with differential speeds, or a fluted runner works against a fixed flute breast. The flutes may be cut parallel to the axis of the cylinder, but spirally grooved rolls and breasts are preferred. Crushing mills with smooth rollers are used for bruising oats, malt and linseed. Cake breakers are toothed roller mills for reducing linseed, rape, and cotton cake to different degrees of fineness, as required by different kinds and ages of livestock.

Turnip cutters, and pulpers, for root crops, are made in great variety. They are generally modifications of Gardner's Banbury turnip-cutter, which retains its popularity. It is a horizontal cylinder provided with knives standing out from its surface, which dig into the roots in the hopper above, and cut out ribbon-shaped or finger-shaped slices. Pulping is effected by providing a revolving surface, either disc or cylinder-shaped, studded with saw-teeth, which rasp and reduce the roots in the hopper to something in the nature of sawdust—thus enabling it to be thoroughly commingled with chaff and meal before being given to stock.

The *Potato-washing* machine is an open sparred cylinder filled with potatoes, and rotated in a trough full of water by a winch-handle; when clean the cylinder is raised up out of the water by a chain wound on the axle—a door on the side is opened, and the washed potatoes discharged —or the spurred cylinder may be provided with an "Archimedian" screw arrangement at its lower end, by which the potatoes are automatically discharged as it revolves.

Steam and hot water *cooking apparatus* form another division of food-preparing machines. Steam is generally

generated in a separate boiler, and by means of a tube from the steam chamber, steam is supplied to the cooking pan that holds the food. There may be two pans, one on each side of the boiler, and these turn on axes for emptying.

Hay and Corn drying Machines.—A portable or fixed receiver for the hay or corn sheaves is connected with a tube leading from a fan, and passing through a furnace to heat the blast, or the hot air may be drawn from the furnace to feed the fan, and by it forced through the hay, thus carrying off the moisture.

A steam corn dryer (Paxman's) will dry 24 bushels of damp grain per hour. It consists of four concentric cylinders 12 feet long. The centre one is 12 inches in diameter for steam from the boiler. It has perforated screw blades on the periphery for working the grain forward which in its progress is acted upon by two steam-heated surfaces and a blast of heated air meeting it. The inner cylinder is driven by spur gear and the fan by a strap and pulley. Gibbs' drying cylinder dries by means of heated air forced into a louvre board chamber inside, which dries the grain as it falls in a shower upon the louvre board from cells in the inner periphery of the cylinder. It dries 100 bushels per hour.

Grain cleaners and separators consist of rotary screens adjustable so as to separate seeds of weeds, and sort the grain into different sizes. The more recent of this class is Shield and Crockett's rotary screen, in which the grain is separated in a spiral path. In another class by exhaust fans, or dressing machines, the grain is separated according to its specific gravity. In a third class the grain flows down short inclines on the louvre board principle. And in a fourth class magnets are placed on an incline

which separate bits of wire, nails, and the like, as the grain flows over them.

Gorse mill.—McKenzie and Sons, Cork. The gorse is fed in between two rolls—the upper spiked and the lower plain; it is next cut into short lengths by rotary knives on a spindle, resembling those of a lawn mower, as fast as it comes from the feed rolls. The gorse chaff falls into the masticator, which consists of two rolls, alternately toothed and plain, the short teeth of the one acting upon the smooth portion of the other. The toothed rings and smooth rings are of equal thickness, about $\frac{1}{4}$ of an inch, and as they fit each other closely nothing escapes their action, and from the greater diameter of the toothed rings they masticate and at the same time clean each other.

Dairy Implements.—Milk is utilised (1) in rearing calves, (2) in towns, (3) in butter dairies, (4) in cheese dairies, and for each peculiar utensils are required.

(1.) In the lac-trephoer (Brooks & Co.) for rearing foals, calves, lambs, &c., artificial teats of vulcanised india-rubber are made outside the milk vessel with tubes inside.

(2.) A milk strainer is a wooden or tin-plate bowl, with hair cloth or wire-cloth bottom. A milk cooler consists of two corrugated plates up between which cold water flows. The milk in two sheets flows down over both plates, and is conducted at foot into a pail below. A lactometer consists of four glass tubes a foot long by 1 inch internal diameter, fitted in a frame. At 10 inches from the bottom each tube is encircled by a line, termed the new-milk line; 3 inches below is graduated in inches and tenths of inches. The tubes are filled with new milk up to the milk

line, and as the cream rises the milk line falls, thereby indicating the percentage thickness of cream. For London, milk by railway is conveyed in cans holding from 10 to 30 galls. and upwards; for other places, as Glasgow, the milk is conveyed in white oak tubs or barrels, filled full and corked, to prevent agitation and churning. Rotary brush machines are now used for cleaning railway cans.

(3.) Milk is either churned whole, sweet, or sour, or it is set in vessels to throw up the cream, which is churned either sweet or sour. Vessels for throwing up cream are made of white oak wood, termed in some places kits, in others, cogs, kegs, and dishes—about 20 inches in diameter by 6 inches deep, rather wider at the mouth than bottom. There are also stone ware dishes, as brown ware, white Staffordshire ware, china, and glass. Enamelled cast iron dishes are also made, likewise enamelled slate. In the Swartz and Cooley systems the cream is raised in deep white iron vessels; in the former these are immersed in water, the latter submerged. Slate or stone tables, or shelves, for setting the pans in cold or hot water, are also used.

Cream is removed either by a skimming dish or by draining off the milk from below, either by tap or syphon. If to be churned sweet this should be done without delay, but when a certain degree of acidity is preferred, as it generally is, the cream is kept in cream jars or crocks. In churning—as soon as the butter comes, the buttermilk is allowed to escape, and pure water substituted.

Churns are of various kinds, as horizontal barrel churns, in which the dashers rotate, others in which the barrel rotates; there are also vertical barrel churns in which the dashers rotate, and plunge churns, and end-over-end and oscillating churns in which there are no dashers, the

cream being dashed against the end of the churn, and atmospheric churns.

Cream separators remove the cream from the milk by centrifugal force. In the Laval machine the cream rises up centrally and is discharged over into the receiver by the centrifugal action of the machine. In the Neilson and Petersen machine the cream is removed by a skimming apparatus. The former, the Laval separator, is preferable, as the skimmers of the latter tend to break the milk globules and injure the butter.

(4.) Gloucester, Cheshire, and Dunlop cheese may be made with the same utensils. The evening and morning milks never mix properly, however well the cream of the former is prevented from rising by stirring it gently about with a stirrer in a deep vessel. The best plan is to make a cheese at every milking. The evening cheese will be the richest in butter. The new milk is put into a tub or pan and curdled in forty to sixty minutes after the rennet has been added. When the curd is formed it is thoroughly broken into small pieces ; the breaker is then withdrawn, a weighted pressure-plate put in, and the whey removed with a syphon. Some break the curd in a curd mill, and press again before putting it into the mould for the cheese press. Up to the scalding of the curd Cheddar cheese is made nearly in the same way. In this case the sides and bottom of the milk vat are double; into the space between, steam from a boiler is turned, so as to raise the temperature of the curd and whey to 100°, and when the curd is "cooked" the whey is removed, and the curd, after due draining and exposure, placed in the moulds.

Cheese presses act on two plans, first by a system of compound levers, actuated by a weighted chain over a

pulley, second, by a system of screw gear actuated in a similar way.

Cheese rooms in our climate require to be artificially heated during a large portion of the year, a temperature of 70° to 75° being desirable—with proper ventilation at the same time. This latter is better effected by stoves, than by water or hot air apparatus.

In Messrs. Carson & Toone's cheese turner, two tons of cheese on shelves 12 feet in length, rest in a moveable frame and can be turned at a single operation.

Live-stock Furniture.—The different live-stock departments of the farm have each special mechanical requirements.

Stable Fittings.—Farm stables should be large, well drained, ventilated, and lighted, and paved with non-absorbent materials. Stalls are generally used with ties. Enamelled iron mangers are cheapest in the end, and low racks are preferable to high ones. Drinking troughs are objectionable. Each horseman should have a pail for watering his horses, fork, curry-comb, brush, foot-pick, feed-measure—and every stable brooms and a wheel-barrow for wheeling out the manure.

Harness should be light but strong. Heavy harness ornamented with brass is objectionable. Collars should fit well and be properly padded. Cart-saddles should have friction rollers so as to allow the back chains to accommodate the movements of the horse in walking. Farm horses should be trained to wear plain bridles—blinkers are objectionable. Each horse will require bridle, collar, cart-saddle, for single cart work, traces for double cart work and plough. Gig harness is also needed, riding-saddle, and bridle.

A Harness-room is best for hanging harness in; it should be furnished with a table, and brushes for keeping the harness clean.

Cow-house Fittings.—Willacey's plan of fitting up houses for milch-cows and cattle generally, may be instanced as an example. A tramway runs up between two rows of stalls, along which a feeding truck is wheeled; the cows being fed right and left as it moves along. There may also be a tramway behind for wheeling out the manure, but a wheelbarrow is more convenient for wheeling the manure on to the dung-hill, so as to mix it with the manure from the stable, &c. Fattening stock are best housed in boxes, and so are young stock. Or where there are covered homesteads, the yards may be divided to accommodate the latter with troughs and cribs.

Pure Water for all kinds of stock has to be provided. When taken from brooks and rivers it may be filtered. Spring water is preferable. Pumps may be at the homestead, but the well should be at a sufficient distance to prevent pollution; and from the well, pipes underground may lead to the pumps in the different departments. When the water has to be raised by force-pumps or rams, cisterns at the homestead will be required, and from these pipes may lead to the departments. Large tanks may be made of galvanized iron, but where slate is at hand a series of small tanks may be conjoined by pipes. All tanks, pumps, and pipes should be protected from frost in their construction.

Piggery Fittings.—A pigstye requires to be furnished for breeding, fattening and store stock somewhat differently. But in each case—there should be two separate apartments—a dining-room open, bed-room roofed—and

each should be kept scrupulously clean. The pig is a cleanly animal in its own way, and, to use an Irish phrase, "a well bred pig" will keep its apartments clean. Sucking pigs have each its own teat, and were each provided with a trough, they could be made to use them, and thus feed separately. The manure, should never be allowed to accumulate, but be cleaned out daily.

Sheep-fold.—The requirements of the shepherd depend much upon the nature of his flock, and how it is kept. For a breeding stock a portable shepherd's van is in many cases required, in other cases a lambing hovel is provided. In each case provision is required for newly-lambed ewes and their followers when on the sick list. A stove is necessary for warming cow milk for lambs, and stuffed hurdles for shelter in blowing weather; troughs for corn, cake, roots, and chaff are also required, covered hay-racks, &c. Chaff may be cut at the homestead, but the mangolds and cake should be given fresh, so that it is better to have them milled in the hovel. For fattening and store stock on turnips in the field, netting, troughs for corn, and hay-racks are required; and when the roots are stored and consumed in the troughs, turnip-cutters are required. When on the pastures in the summer time, a bottle of ointment for the fly may be all that is needed. Sheep washing, dipping and smearing involve other mechanical appliances, and at shearing-time the shepherd requires sheep-shears, and a stool, also a weighing machine for weighing the wool, corn, and cake bins; measures. One or more weighing machines for livestock are desirable for testing the progress fattening sheep are making.

Poultry-Yard.—Poultry farming, whether for rearing and fattening fowls, or for the production of breeding-

stock and eggs, may involve a considerable investment of capital for mechanical appliances—as incubators, nursing mothers, feeding apparatus, house accommodation, &c. In the winter time artificial heat may be required, and in the summer shade from the sun. Roosting and nesting places, and coops require to be kept clean, otherwise fowls young and old will be infested with insects. Poultry infested with insects will neither fatten, nor lay eggs to pay for their keep. A plentiful supply of water is necessary, but the spilling of water and wetting of coops and feeding places should be avoided. Proper fountains for supplying water and food, so as to obviate any spilling, &c., are desirable; a good deal has been said about "sand baths" and they are generally necessary and always desirable.

Carts, Waggons, &c.—Carts are classed as (1) single horse-carts for general purposes, (2) harvest carts, (3) market carts on springs, (4) carts with pumps attached for the conveyance of water, (5) lorries or other vehicles for the conveyance of implements, (6) carts with crank axles and low bodies—sometimes termed "builders' carts." And waggons: (1) pair-horse waggons, (2) light waggons on springs, (3) other waggons for three or four horses, (4) shepherds' huts on wheels, and vans with fittings for men engaged in steam culture.

Prime Movers.—Steam engines, water-power, windmill, horse gear, &c. Small fixed steam engines may be supplied with steam from vertical and semi-portable boilers. Large ones have generally either Cornish or Galloway boilers.

The bed-plate of a small engine may be bolted to the

feed-water tank of the boiler. In either case it should have a feed-water pump and feed-water heater for supplying the boiler. A Cornish or Galloway boiler should be well stayed and fitted with manhole and mudhole covers, check valve, two safety valves, blow off cock, gauge taps, glass water gauge, steam pressure gauge, firing tools, oil feeder, and complete set of wrenches, screw hammer, and spare gauge glasses. Compound engines, universally used in other arts, are now also at work in agriculture.

Traction engines are preferable to portable, as they move themselves from place to place, hauling after them threshing machines and other driven machinery, with water carts, waggons, sleeping vans, that may be required. Thus, by attaching winding drums to them they may be used for ploughing and cultivating land, as already noticed; also for hoisting in quarries, mines, &c. Springs are being applied on the wheels by several makers. Improvements in the manufacture of steel allow it to be substituted for iron with advantage, as it is lighter, stronger, and more durable. Vertical boilers, as Paxman's, have a number of water tubes, which curve up through the fire-box, terminating in the steam chamber, each tube having a deflector on the top to prevent spray. The Cochrane vertical boiler has horizontal tubes.

Horse Gears are of two kinds: high and low. In the former, generally known as "the horse mill course," the gearing is above the circular path in which the horses work, the large wheel which drives the lay shaft being supported on a vertical shaft. In the low class, by far the most numerous, the driving gear is on the ground, the horses stepping over the lay shaft as they move round in a circular path.

Water power.—Water-wheels are of four kinds : (1) the over-shot, in which the water falls on the top of the wheel ; (2) the breast-wheel, in which the water is led on about level with the axle ; (3) the under-shot wheel, driven from below by the force of the flowing stream, and (4), the turbine wheel, in which the water acts horizontally upon arms forming a vertical axis. This latter is the oldest wheel. It has of late been greatly improved in detail, and is now fast superseding the other three kinds.

Windmills are of two kinds : (1) "Post mills," in which the whole structure forming the mill-house turns on a vertical bearing or post so as to permit of the "axis of the vanes," or sail arms turning with the wind ; (2) Tower mills, in which the roof, or "cap" with the sails, turns on the mill-house, of a circular or tower form. Wind-power in various forms is still employed for pumping from wells, and in apparatus for draining fen lands ; but steam is now generally preferred for either purpose.

CHAPTER II.

FARM EQUIPMENT.

Horse power.—Live Stock.—North Charford Farm.—A Midland Dairy Farm.—Hill Country Farm.—North Country Farm.—North Lincolnshire Arable Farm.—Worcestershire Farm.—General Conclusions.

THE equipment of the farm depends on the work involved in its cultivation, and on the quantity of food for consumption by live stock which it annually produces. The former of these conditions hinges on the character of the soil and its cultivation, the latter mainly on its fertility. When land is wholly arable a team of horses may be required for every 60 acres; and whether that team be a pair or three or even four horses depends on whether the land be light or heavy. Where there is any considerable area of pasture on the farm, or when, in the crop rotation, the land remains more than one year in clover, the cost of labour is of course diminished. As regards the provision of live stock for the consumption of the home produce and purchased food, that, too, depends on soil and management. Whether sheep or cattle be the prevalent stock depends on the character of the soil, the former being better adapted to the lighter and dryer soils, the latter to farms where there is much straw grown for consumption and bedding in yards, and much grazing ground to be depastured during summer.

The number of horses required upon a farm was amply illustrated in a paper on Horse Power published in the nineteenth volume of the English Agricultural Society's Journal. And we quote some of the examples there given,

with the number of horses required under the circumstances of each case.

Number of Horses.	Acreage.		Acreage.			
	Pasture.	Arable.	Fallow Crops.	Grain Crops.	Clover, &c.	Pulse, &c.
20	...	660	110	330	110	110
20	400	560	140	280	140	...
11	43	400	91	182	85	42
8	110	310	78	155	57	20
5	41	128	32	54	37	5
7	400	200	50	100	50	...
7	100	200	50	100	50	...
12	120	330	77	175	68	10
7	60	250	63	125	42	20
12	...	300	75	150	75	...
11	400	340	90	150	45	55
14	400	400	120	185	80	15
12	274	408	60	174	174	...
29	120	900	235	450	150	65
16	75	500	120	240	140	...
12	6	240	50	120	60	10
10	...	300	100	150	50	...
22	...	600	150	300	150	...
20	...	900	200	340	340	20
20	...	675	125	300	200	50
7	...	240	60	120	30	30

In the paper from which these figures are extracted there is an elaborate discussion of the cost of horse power per annum, on the several farms of which details are given. It varies from 30*s*. to more than 50*s*. per acre of the arable land, being greatest of course where a laborious rotation is adopted, and where there is also a considerable area of pasture land in addition, on which of course, horse power to some extent is needed.

As to the quantity of stock needed on a farm, of that too we shall give examples. A judgment may, however, be formed

by calculation of the quantity of green food which the scheme of cultivation will provide each day—dividing it by 25 or thereabouts, as the weight in pounds which a full-grown sheep will consume daily, and thus arriving at the number of sheep which the farm is capable of keeping month by month. If you count a calf as equal in its consumption to 2 sheep, a yearling as equal to 3 or 4, a full grown beast as equal to 7 or 8, and a horse as equal to rather more, you can estimate the number of every kind of stock which your land may maintain. You will consider hay as equal to five times its weight of green food. You will calculate the aftermath as equal to three-fifths of the mown crop. You will put your grass at weights varying from 8 to 10 tons per annum, your clover at 10 to 12 tons, your vetches at 8 or 9 tons, your turnips at 12 to 20 tons, your mangels at 20 to 30 tons per acre. You will put so much of your straw as you can consume as equal to probably three fold its weight of green food; and grain and cake bought or grown as equal to from 10 to 15 times its weight of green food. With these data you can calculate within the limits which the variations of seasons and productiveness impose, what stock, after providing for your horses, you can keep in each month. And having resolved upon a certain scheme of stocking you must arrange your cropping so as to be sure that the supply which every week will need is then forthcoming. How many cows you shall keep and how many calves you shall rear, and either fatten at 3 years old or dispose of as in-calf heifers at a similar age: how many ewes you can keep, disposing of the produce either as lambs at six months or as shearlings at fourteen, or perhaps supplementing their number by purchases in autumn to be fed off fat in the following early summer: how many sows you shall keep,

and how many pigs you shall fatten:—All these conclusions can be reached with some safety on the data thus supplied.

It is, however, safer to give, in the case of a number of farms, the actual equipment which exists than to depend on calculation; and the following accordingly are a number of examples by which the reader can guide himself.

(1) **North Charford Farm,** at Downton, Salisbury, leased by Professor Wrightson, and now known as the College Farm, is 550 acres in extent. Like most of the farms in its district, it is long and rather narrow—consequent upon the general practice of allotting a share of water meadow and river frontage, of good alluvial land, and of middle land and down, whether broken or unbroken, to each occupation. These farms, therefore, comprise a considerable variety of soils, and most of them include areas of irrigated meadow, marsh, dry pasture, down, alluvial land, and chalk soils of varying depth and quality. These peculiarities mark them out as suitable for three important uses—(1) sheep; (2) corn; and (3) dairy.

The arable land is of fair quality throughout, and capable of yielding, per acre, in fine seasons, and when well managed:—7 to 8 sacks of wheat; 8 to 10 sacks of barley; 15 to 20 sacks of oats; 12 to 20 ton of roots; 15 to 30 ton of mangel; 10 to 12 ton of cabbages; 1½ to 2 ton of hay. The land is all worked with two-horse teams, and these are yoked abreast. The arable land naturally dry, can be worked even after severe rains, and is admirably suited for sheep. The flock, in fact, regulates the cropping and general outlines of management. The dairy leads a somewhat independent existence, being chiefly maintained upon

the water meadows, and it does not control the general management.

The typical rotation may be stated as follows :—1, vetches fed and followed with late turnips; 2, early or forward turnips; 3, wheat; 4, barley; 5, roots; 6, barley; 7, clover; 8, clover; 9, wheat. This rotation is well suited to thin and high-lying soils, as it provides a large share of sheep keep, and generally secures good crops of wheat and barley. The middle ground, lying between the down and the alluvial tract, is managed chiefly on the five-field course as follows :—(1) fodder crops, followed by roots; (2) barley; (3) clover and seeds; (4) second-year clover; (5) wheat. Occasionally the seeds are allowed to lie a third, fourth, or fifth year. The alluvial land, being near the buildings, is cropped extensively with mangel wurzel and cabbages, and in other respects may be considered as managed on the four-course system, with more of wheat than other cereals.

It would be difficult to find a system of farming in which activity is more continuous throughout the year than here. To give a general view of it, we find the lambing down of a flock of over 500 ewes taking place chiefly in January. February, March, and April are occupied by the preparation for and sowing of spring corn. April, May, June, July, and August are devoted to the gradual sowing of mangel, swedes, and rape, and of early and late turnips. Each of these crops succeeds some fodder crop fed off the land by sheep :—Winter rye fold comes in for mangel and forward rape or turnips. Winter barley and trifolium folds come in for swedes. Winter vetches fold comes in for swedes, yellow turnips, and late white turnips.

There is no rest, no winter fallowing, but double cropping throughout, which greatly enhances the seed bill. In

the midst of these activities comes haymaking, first on the uplands, and then on the water meadows; and harvest is generally announced before the last load of hay is brought in. There is no rest after harvest. There is a positive excitement to get in trifolium seed, as the success of this important crop depends upon early sowing. Wheat stubbles must be cleaned, and got into rye, vetches, and winter barley, for spring feed; and then there is the wheat land to plough up, and get ready for sowing. It is a busy and exciting time from January 1 to December 31, and teams are working at high pressure the whole twelvemonth.

This system entails a large amount of capital, a large outlay in labour, and a long seed bill. The valuation made at Michaelmas, on moderate estimate, amounted in 1880 to £7451, or £13 18*s.* 6*d.* per acre; in 1881, to £7129 3*s.* 9*d.*, or £13 6*s.* 6*d.*; in 1882, to £7906 14*s.* 6*d.*, or £14 7*s.* 4*d.*

Twenty-two dairy cows, two heifers, and two dry cows are valued at £392 10*s.* The valuation of the flock (Hampshire Down sheep) is higher than usual, on account of the extraordinary rise in the value of sheep stock of all kinds;—200 ewe tegs, at 50*s.*; 300 4 and 6-tooth ewes, at 75*s.*; 1 ram; 10 small ram lambs, at 45*s.*; 8 ram lambs at 70*s.*; and 200 2-tooth ewes, at 75*s.* The whole sheep-stock is valued at £2432. Fourteen horses and 2 ponies are valued at £482; and nearly 100 pigs of all ages at £140; and there are £22-worth of poultry. The list of implements for this farm of 550 acres of light, chiefly arable land, is given as follows:—5 ploughs, 3-furrow plough, 2-wheel presser, 3-wheel do.—covered waggon, 5 waggons, water-cart, 8 dung carts, 2 pony carts, spring cart, 2 shepherds' houses on wheels—2

Coleman cultivators, grubber, Cambridge roller, 4-horse plain roller, 2-horse plain roller, iron drag on wheels, 2 sets of 4-horse harrows, 3 sets of 2-horse harrows, 3 sets of chain harrows, drill harrow, Garrett's corn drill, water drill, Tasker's horse hoe, Garrett's horse hoe, turnip scuffler—2 horse rakes, Hornsby reaper, Samuelson's mower, 8-horse power engine, threshing machine, elevator and horse gear, horse gear complete and fixed—winnowing machines, Boby's screen, weighing machine—Richmond's chaffcutter mounted on wheels, Amies and Barford's grist mills, Amies and Barford's steaming apparatus, Bentall's pulper, Gardner's turnip cutters—troughs, hurdles, cribs, rails, lamb creeps, ladders, drag rakes, portable fowl houses, barrows, harness, forks; scythes, water casks, whippletrees, corn bushels, corn scoops, stable baskets, corn bins. Also dairy utensils—viz., churn press, barrel churn, cheese tubs, curd breaker, mills, milk refrigerator, milk "churns" (cans), tressels, cheese vats, weighing machine, butter washer, butter tub, butter boards, skimmer. Poultry yards and fittings, Christy's incubator, artificial mother. Also ropes, spades, shovels, baskets, mud scrapers, crowbars, turnip pickers, besoms, turnip knives, plough cords, cart jacks; riddles, sacks, &c.

(2) **A Midland Dairy Farm.**—Of 244 acres, 200 are under grass, and 44 under plough. Of the 44 acres, from 8 to 10 are annually under green crops—viz., 7 acres swedes, 2 cabbage, and 1 potatoes and mangels. The rotation of the arable is half way between a four-course and a five-course; but there is no regular system of succession. Seeds are not taken oftener than once in six years. Wheat is grown only in sufficient quantity to find thatch and a little litter. About

10 acres every second year are sufficient for this purpose. Barley is more grown than either wheat or oats, and there are no pulse crops. There was actually under cropping in 1883 17 acres barley, 6 acres clover, 10 acres green crops, and 11 acres from which a crop of second year's clover had been made into hay, but since ploughed up and fallowed as a seed-bed for wheat to be sown in October. Two crops of clover were mown from it in 1882, so that three mowings have been made into hay in two years. Although a large quantity of manure is made from cattle and sheep liberally fed, still the swedes are generally grown by the use of only mineral superphosphate and nitrate of soda.

There are 34 acres of upland meadow, and of this about 10 acres are kept in good heart by the application of liquid manure, collected first in tanks, and then by means of chain pumps pumped into a barrel on wheels and carted on. The remaining 24 acres meadow are manured annually either with manure carted on, or with cake fed on. Eleven acres of this meadow were, ten years since, old tilled arable land; but by annual dressings of farmyard manure, and by continuous consumption in spring and autumn of oil-cakes, fairly good mowings are now got every year. Of the remaining 164 acres in pasture, 59 acres are of new turf.

The whole area of the farm—putting on one side house, buildings, garden, &c.—is 240 acres of cultivable land. Of this whole, less than one-fifth is sufficient for straw and green crops. About one-seventh is sufficient for hay—always bearing in mind that there is also the annual help of, say, 8 acres of clover hay from the arable land.

Three waggon mares are the staff of farm horses, and two of these are annually used for breeding, the foals being sold. From forty to forty-five dairy cows are kept, from which

cheese is made at home from March 1 to December 1, and for the other three months milk is sold. About twenty calves are annually reared, half heifers, half bullocks. The former are brought in to the dairy at 2 years old, and the bullocks are sold at about 20 months old. The summer stock is heavier than the winter stock, both in beasts and sheep. During the summer there are the dairy cows and a few feeding beasts, say, in all fifty—besides twenty 1½-year old heifers and bullocks, twenty rearing calves, and one bull. Out of the dairy cows the worst milkers (some six or eight) are made fat before Christmas. When the fat beasts and the 1½-year old bullocks have been cleared out, instead of about ninety head, there remain about seventy for wintering. These are fed on cut straw and hay, pulped roots, rice meal, and oilcakes, either of decorticated cotton cake or linseed.

The sheep are a more uncertain quantity than the cattle. and are reduced or increased, as there is room and food for them. On the average in the summer there are from 150 to 200 head, including lambs, and in winter the stock is reduced to forty in-lamb ewes. Their lambs are not wintered, but are sold either fat or as stores. Shropshires are kept, and in 1882 all the males were sold as ram lambs, and the ewe lambs for store.

Pigs are not bred, but from eighty to ninety are annually made fat, being bought in at about 55*s*., and sold out, after being fed on whey and ricemeal, at about £5 10*s*. per head.

About £50 worth of mineral superphosphate and nitrate of soda are annually bought; and about £450 worth of cattle food are annually bought; half decorticated cotton and linseed oilcakes and half ricemeal. The actual amount of livestock, on August 20, 1883, was as follows:—Forty-seven in-milk and in-calf cows, of which 4 are nearly fat;

20 1½-year heifers and bullocks; 2 bulls; 26 rearing calves, of which 5 are bulls; 164 sheep and lambs; 3 waggon mares, two of which are in foal (no foals last year); 1 cob; and 29 nearly fat pigs.

The implements used are one Howard's pair-horse plough, one Howard's ridging plough, two 1-horse scarifiers or horse-hoes, one pair-horse cultivator, one set of pair-horse iron harrows, one 3-horse heavy harrow, one heavy 1-horse roller, one light ditto, one turnip and mangel drill (a corn drill is hired), one chain harrow, one turnip pulper, and one chaffcutter, one horse rake, one haymaker, one combined mower and reaper, one liquid-manure cart, three waggons, three carts. The pulper and chaffcutter are driven by horse power, and are worked together by three horses and three men—one man feeding the chaffcutter, one man feeding the pulper and mixing the chaff and pulp, and one man driving the horses and throwing in the roots.

(3) **Small Hill Country Farms.**—Mountbarrow Farm is 190 acres in extent, 1½ miles from Ulverston, North Lancashire. The soil is a medium loam, on the limestone formation, dry without draining. During the year 1883 there were 65 acres under the plough—namely, 25 acres of green crop, comprising 7 acres of potatoes, half an acre of mangel, half an acre of carrots, 2 acres of common turnips, and the rest swedes; 8 acres of wheat, 9 acres of barley, and 23 acres of oats. The rest were in grass seeds, hay meadows, and pasture.

The farm is cultivated on the four-course system—lea, oats, green crop, wheat or barley with seeds. Potatoes are manured with about 10 tons per acre of farmyard manure. Swedes, mangel, and carrots get about 5 tons of farmyard

(more if it is available), and 5 cwt. of superphosphate. About 17 acres of meadows and 22 acres of seed grass are annually mown for hay, after which stock are pastured upon them, and by this means they are manured; or they may have, additional, 4 cwt. per acre of guano and salt—two-thirds guano to one of salt. Sheep, cattle, and horses, fed on the land, keep the pastures in heart, with the addition of 5 cwt. per acre of bone meal about once in five years.

The live stock of the farm, in addition to pigs and poultry comprises about twenty milch cattle, one-half of the milk being sold as whole milk in the neighbouring town, and the other half made into butter. A Shorthorn pedigree bull is kept. All the heifer calves are reared, the bull calves are steered and fatted, with other bullocks brought in, as fodder will allow. Some ten or twelve bullocks are annually fatted. The ordinary food grown on the farm is supplemented by oilcake and peameal. Six work horses are kept, including a couple of brood mares, usually put to a Clydesdale sire. About 100 sheep are wintered, of which sixty to seventy are breeding ewes, half and three-parts bred Leicesters. The ewe lambs are kept, and the ram lambs fatted for butcher, and also the drawn ewes, the young ones taking the places.

The implements comprise threshing machine, worked by horse power, but the aid of the steam thresher is got when possible; 2-horse mowing machine, 1-horse reaper, hay rake, hay elevator, double turnip drill, corn seed drill, 5 yards wide, one double-furrow plough for lea, two single ploughs for fallows, two double mould-board ploughs for ridging: two scufflers, three sets of seed harrows, one chain harrow, one grubber, one iron roller, two saddle harrows, five tilt carts, forks, rakes, &c. The labour

employed, in addition to the tenant and his sister, and extra help at hay, grain harvest, and turnip singling, consists of three men and two boys, the wages varying from £32 to £10 per annum, apiece, with board and lodging in the house: also one woman and one girl, wages £20 and £10 per annum, with board and lodging. The tenant keeps his land in fair condition, pays his rent, and makes a provision for the future.

(4) Old Hall Farm, High Furness, Lancashire, stands midway between the mountain and lower farms. It comprises 85 acres; the subsoil is gravel. The tenant works the farm on the seven-course, and this year he has 14 acres of oats (the climate is unsuitable for either wheat or barley), 6 acres of swedes, some 2½ acres of cabbages, mangels, potatoes, and carrots. He cuts 12 acres for hay, and the rest is in pasture. The tenant's only specifics are cleanliness, liberal, not extravagant, manuring and feeding, combined with economy and close personal supervision.

The live stock of the farm consists of three work horses, twelve milk cattle, showing good Shorthorn characteristics; one Shorthorn bull, six 2-year-old cattle, seven yearlings and seven calves. One brood sow, with nine young ones, and four store pigs, for sale and family use as bacon, thirty ewes, half and three-parts bred Leicesters, forty-seven lambs, and one Leicester ram. As a rule, about seven beasts, of home breed, are annually fatted—bullocks, and cows that have ceased to breed. The heifer calves are brought up to supplement the stock of milk cattle. Only some half-dozen ram lambs are sold fat when prices are best, as the tenant finds it pays him best to sell them as hoggs when the mutton market is dearest. Roots and oats are the principal foods, supplemented with cake and cotton

cake. Through winter both fatting sheep and breeding ewes have an allowance of crushed linseed cake and oats. The implements comprise a 2-horse threshing machine, 2-horse combined mower and reaper (this has been in use fifteen years), a 1-horse hay elevator, one horse rake; a horse chaffcutter, corn crusher worked by the same gearing as the thresher, oilcake crusher; one double plough, single plough, turnip drill (single), iron and wood harrows, scuffler, grubber, three tilt carts, forks, rakes, spades, &c. The labour of the farm is done by the tenant and his three sons, 12 to 16 years of age, who go to school again in winter time. The work of the house, dairy, &c., is performed by the daughter and a girl, whose wage may be £12, with board and lodging.

We may mention as a very sensible part of farm equipment that the tenant's practice is to supply each son with an account book, in which are kept records of all the sales and purchases—sales of fat stock, butter, eggs—showing daily, weekly, monthly, quarterly, and annual totals; also of the amount of manures and foods purchased for land and live stock. By this means one year's sale and profits of live stock can be contrasted with the past at a glance. By this means, also, one month's record of butter produce can be contrasted with another.

(5) **A North Country Farm.**—There are here 610 acres, 550 acres of which are arable, and the rest permanent pasture. The 610 acres are divided into two farms—the one containing 314 acres, and worked on the eight years' course (three years grass), and the other containing 296 acres, worked on a seven years' course. The two farms lie together, but are generally worked separately, except at a

push—such as seed-time and harvest. On the 314-acre farm four pairs of horses and an odd horse are kept, and sometimes a young horse, which works about two days per week from March to May. On this farm they have 40 acres wheat, 36 acres barley, 38 acres oats, 4 acres tares, 3 acres fallow, 25 acres hay, 106 acres grass (16 acres of which were young grass pastured with early lambs), 38½ acres turnips, and 22½ acres potatoes. On the 296-acre farm they have three and a-half pair of horses, working 32½ acres wheat, 32½ acres barley, 61 acres oats, 25 acres hay, 20 acres grass (10 acres of which were young grass pastured), 16 acres potatoes, 32½ acres turnips, 10 acres fallow, 4 acres beans, and 62½ acres permanent pasture. On the larger farm there are four horsemen and a cattleman; on the other, a cattleman (who is also foreman), a shepherd, and three ploughmen, one of whom gets weekly wages, and is included among the odd men. The wages of all the men average about £44 10*s*., including perquisites, or a total of £400 10*s*.; while from the labour book it appears that extra men and women cost £234, and bread and beer during harvest cost £20, or a total of £654 10*s*. for 624 acres (including the 12 acres extra hay), or rather less than £1 1*s*. per acre. The women workers get 1*s*. 2*d*. per day, 2*s*. 3*d*. during harvest, and 2*s*. for potato lifting. There are thus sixteen horses on the two farms—nine on the one and seven on the other. Very few calves have been reared for a number of years back, as it has been found cheaper to buy English or good Irish stirks. Six cows are kept at the home farm, and a man at the off farm has a cow for providing his men. From eight to ten calves are usually brought up. There are generally 95 to 105 head of cattle during the winter, about fifty being fed, and the

rest, cows, calves, and stirks, wintered for next season's grass. They generally also feed during summer in the courts twelve to twenty cattle, and graze about fifty head; generally buying in some in April and June for grazing, and in October for wintering. Of sheep a small flock of breeding ewes is kept—thirty to forty half-bred ewes for early lambs, and forty black-faced ewes. The early lambs get young grass or clover, and a liberal allowance of cake; lambs and mothers generally all away by August 1. Two hundred and fifty cross-bred lambs are fed during winter, and and about 100 hoggs are fed in summer. Few pigs are kept; only as many as are needed for the house. Two sows are kept to supply pigs for the servants.

The following list of implements will show those in use on this farm: — Four self-delivery and manual Bisset's combined reapers and mowers with rakes attached, one mower, two American tilting hay rakes, two horse rakes, ten ploughs, one double-furrow plough, five drill ploughs some of them fitted with extra shares for lifting potatoes), four Tennant's grubbers, one 4-horse grubber, one Norwegian harrow, five drill grubbers, eleven iron harrows, four sets of zigzag harrows, four sets of toothed harrows, one set of chain harrows, one circular harrow, four drill harrows, one patent double drill harrow; three wooden rollers, three stone rollers, two cast metal rollers, two turnip barrows, twelve tilt carts, eight corn carts, two wood carts, one water barrel, one cake crusher, one corn bruiser: ten ladders, barn utensils, potato barrows and riddles, sheep troughs, nets, hurdles, &c., harness and stable implements, spades, shovels. and forks; also potato-digger and winnowing machine.

(6) **A North Lincolnshire Farm.**—There are 216 acres arable, and 87 acres pasture.

The crops this year, 1883, included:—wheat, 36 acres, (14 acres less than usual): barley, 57 acres; oats, 27 acres; beans, 6 acres; tares, 6 acres; potatoes, 2 acres; mangels, and swedes, 10 acres; cabbages, 1 acre; turnips, 27 acres: clover, 44 acres.

The live stock include 8 cart horses, 21 cows and heifers with calves; 24 calves; 7 heifers in calf, (2½ years old); 12 heifers (1½ do.); Shorthorn bull, 140 breeding ewes; 145 lambs; 30 sold fat in May and June; 45 shearling gimmers; 2 rams; and 30 pigs of all ages.

The implements include:—3 waggons, 2 and 3 horse; 3 Scotch carts; 1 corn drill; 1 turnip drill; 1 reaping machine; 1 hay rake, (for one horse); 4 ploughs; 1 ridge plough; harrows of various sizes, (strong and light); 1 patent drag harrow; 1 duck-foot harrow; 1 Cambridge roll; 1 light flat roll; and sundry small and unimportant tools.

(7) **A Gloucestershire Farm** of 490 acres; 370 pasture, 120 arable: 30 acres of the arable is strong clay, the remainder good deep loam. The pasture land is much the same, produces large crops of grass, and keeps a large stock of cattle and sheep, as under (Aug. 23, 1883):—

The cattle include 30 dairy cows, 10 two-year old heifers (to calve next spring); 41 yearling heifers; 9 yearling steers; 40 fatting heifers and oxen; 69 calves weaned in the winter and spring; 1 bull.

The stock include 220 breeding ewes, 156 fatting sheep; 20 rams for use and sale; 262 ewe, wether and ram lambs; 10 working horses, and 3 colts. And of pigs, 7 breeding sows; 18 young pigs.

The implements of the farm include:—4 waggons, 6 carts; 5 ploughs; 1 ridge or banking plough; 2 horse-hoes; 2 scarifiers; 1 iron roller; 1 Crosskill roller; heavy iron drags; duckfoot drag; 2 sets iron harrows; turnip and manure drill; 3 turnip cutting machines; 2 hay-making machines; 1 horse roller; hay and straw elevator; 2 mowing machines; oilcake crusher; winnowing machine; threshing machine, chaffcutter, root pulper, corn crusher, and cider mill—all worked by a 4-horse power turbine wheel.

70 dozen hurdles, 20 sheep racks; 20 troughs; heel rakes; ladders; hay and dung forks, &c.

Arable land at present (August,) under the following crops:—38 acres wheat, 20 do. oats; 5 do. barley; 15 do. beans; 19 do. swedes and turnips; 5 do. mangold; 2 do. potatoes and cabbage; 13 do. fallow after vetches fed off.

(8) **A Worcestershire Arable Farm.**—We take one example from the Blue Books of the Royal Agricultural Commission. Mr. C. Randell employs a capital of £11,500, on the Chadbury Farm, near Evesham, of 675 acres, comprising 390 arable, and 175 pasture and meadow. Two-thirds are clay, and the remainder lighter land. He keeps 23 farm horses, besides hackneys—30 cows (their produce being kept, and some 30 fat beasts sold every year), and a flock which in winter time amounts to 750 home-bred ewes and tegs, and 200 purchased sheep, the sale amounting to 350 fat sheep, 60 rams, and 70 ewes annually.

The Labour Bill of the farm amounts to from 58*s.* to 60*s.* per acre—wages being 13*s.* 6*d.* a week in winter, 15*s.* a week in summer, and 30*s.* a week during harvest. A summary of the annual balance-sheet, described as the

annual "average" experience, is added as illustrating the general subject of farm equipment on a highly farmed, chiefly arable, farm, where there is a good deal of expenditure on what may be called garden crops.

AVERAGE ANNUAL RECEIPTS.

By sale of corn	£2,413	8	9
,, Live stock	3,127	3	10
,, Wool	356	5	0
,, Farm seeds and vegetables	551	2	2
,, Fruit	71	15	0
,, Hay and straw	39	13	2
,, Sundries	126	8	2
By valuation at end of year	9,553	15	8
	£16,239	11	9

AVERAGE ANNUAL EXPENDITURE.

Valuation of live and dead stock at beginning of year	£9,536	8	5
Rent, rates, and taxes	1,097	15	9
Labour	1,693	8	4
Live stock bought	989	13	5
Feeding stuffs bought	1,474	15	3
Artificial manures bought	528	4	7
Insurance	13	14	10
Sundries, including tradesmen's bills, half cost of repairs, seed corn, &c.	752	9	1
Balance	153	2	1
	£16,239	11	9

These eight examples of farm equipment are somewhat loosely and unsystematically described; but in one or other of them the reader will probably find a case corresponding to his own, from which a lesson may be obtained.

GENERAL CONCLUSIONS.

Quantity of Horse-Power—First as to the horse-power employed on a farm: The conclusion from the table on

page 32, is that 182 horses suffice for the cultivation of 8841 acres of arable land, and 2549 acres of pasture: 2133 acres, nearly quarter of the arable land, being in clover and grass, 2076 in green and fallow crops, and 4632 acres in grain crops. This corresponds to a pair of horses to every 56 acres or thereabouts of arable land, and every 15 acres or thereabouts of green and fallow crops.

We add in another table the experiences of the eight farms just enumerated.

No.	Horses. No.	Acreage.		Fallow. Crops.	Grain Crops.	Clover.
		Pasture.	Arable.			
1.	14	50	500	166	222	112
2.	3	200	44	10	17	17
3.	6	105	85	25	40	20
4.	3	35	50	9	14	27
5.	16	60	550	134	240	176
6.	8	87	216	44	126	56
7.	10	370	120	39	78	—
8.	23	175	390	—	—	—
Total .	83	1082	1955	427	737	408

Adding up these, with the exception of No. 8, we have a total of 60 horses employed on 1565 arable acres, and 997 of permanent pasture. Here we have a pair of horses to every 52 acres of arable land, and every 13 acres of green or fallow crop; but there is in these cases a much larger proportion of old pasture held with the farms than with those previously enumerated, and a certain quantity of horse labour is required for that.

If we take from the seventh farm in the above table, the 5 horses required for its arable land, then it will appear that a pair is needed for every 150 acres of pasture—and subtracting that number accordingly, for the total amount of

permanent pasture in the table, it appears that the horse power needed for plough land of all sorts is 69 for 1955 acres, or a pair for every 57 acres of arable land, or (calculating without the use of the 8th farm in the table) one pair for every 16 acres of fallow crop.

But as we ought to aim at the utmost economy, and not only at the average, it is worth while considering the cases of one or two individual farms on our table. In the north country farm, No. 5, there are 16 horses worked on 610 acres, of which 550 are arable, and 134 are fallow crops, including no less than 38 acres of potatos. Deducting one horse for the 60 acres of permanent grass, we have 15 horses managing 550 acres arable of which 134 acres are fallow crops; and this is a pair for every 73 acres arable, much of it being a remarkably laborious fallow crop.

Hand Labour.—The greater economy of Scotch farms will be still more distinctly brought out, if the provision of hand labour for the farm is also considered. The cost of this per acre varies of course according to the quantity of grass as compared with grain and fallow crops grown on the arable land. And it varies exceedingly according to the size of the farm and the custom of the country. On a small Cheshire farm—carrying however a herd of 30 dairy cows—with about 40 acres of arable land, a single man throughout the year, with help at harvest time, will, with the farmer and his family, sometimes suffice. Elsewhere the labour will generally amount to from 30*s*. to 35*s*. per acre, according to the rotation of cropping adopted, and the proportion of land which is every year accordingly in clover; and it often amounts to more than 40*s*. an acre.

In the case of the fifth farm in the above table it will be

seen that the cost of labour did not exceed 21*s.* an acre, where 550 acres out of a total of 610 were arable—176 indeed, being clover, but 134 being fallow crops of very heavy kinds. Here only 9 men were employed with horses and livestock. They were paid on the whole £44 10*s.* annually, or about 17*s.* a week apiece throughout the year —and the total amount of extra labour employed did not exceed £234 a year. Women are largely employed on Scotch farms, as in turnip hoeing, manure spreading, potato planting and harvesting; and at corn harvest too. If this be contrasted with the Worcestershire farm, No. 8 on our list, where, however, a considerable extent of land is devoted to what may be called garden produce—fruit, cabbage growing, and other vegetables—the contrast is great. The labour bill amounts here to about 58*s.* an acre, wages being 13*s.* 6*d.* in winter, 15*s.* in summer, and 30*s.* a week during harvest.

The tenant of a farm coming newly to his occupation will generally find the land already provided with its labourers; and his work of reorganizing the work must not be violently set about. The introduction of piece work payments will enable him gradually in all probability to improve the previous practice. The quickening of the whole practice of the farm, which this will enable, will be the first step towards ultimate economy. And in the adoption, if possible, of altered horse management in districts where the practice prevails of working from 7 till 2, with an idle hour in the field for a mid-day bite, there will be another opportunity of economising and quickening the whole labour of the farm. Undoubtedly English farmers, have, as a rule, a great deal to learn from north country men, in just that part of farm practice which

is at present the great difficulty in the way of farm profit. The difference between the cost of labour now and formerly is not greater than the difference on this point which has all along existed between the South and the North. And this is true, notwithstanding the higher wages which obtain as a rule in north country farming. We are dealing with it, generally in the Southern counties, rather by laying land to grass and adopting less laborious cultivation. It would be even better could the difficulty be overcome by making such labourers as we employ more efficient, so that the smaller number now at our disposal might be enabled to do the work which formerly employed them all. That this will be better for the men is seen in the higher wages of the northern counties just referred to, where certainly that is the solution of the difficulty in question; and, that it will be better for the master to have a smarter, quicker system at his command needs no argument to prove.

Livestock.—The equipment of the farm in this point depends on the quantity of food for them which every month provides. This of course determines the number of mouths to be fed which may be required. The kind of stock selected for the consumption of this food depends on soil, climate, and circumstances. Sheep are the stock chosen for uplands, downs, and dry-soils generally, with just cattle enough to provide the yard-manure which some of our crops require. Cattle are the stock preferred on lands unsuited for the sheep-fold, for rich pastures, and of course for pasture lands of second quality adapted for the dairy.

There are, however, exceptions even to a general rule of this kind. Even clayland farms where arable culture exists, where there are steep slopes, or inaccessibility by distance

from the cattle yards, may be fertilized by sheep-farming; vetches and cabbages being grown for summer folding, and a certain amount of grassland being available for use in wet weather. The sheep-fold is the only system by which the whole of the manure derivable from crop consumption is returned to the soil; and by itself, without other manure, a certain amount of added purchased food being also given, it is sufficient to maintain fertility, in spite of the continual draught upon the land made by the corn sales of the farm. And it is well wherever possible to adopt a system of manuring which involves the very minimum of the labour required to apply the fertilizer and distribute it. A more liberal manuring is given at less cost for labour in this way than in any other. In a field of roots—20 to 25 tons per acre—fed off by sheep receiving 1lb. each of cake a day, the manure applied means 1 ton of cake consumed per acre, which is quite the maximum of added fertility known to ordinary farm practice; and this is applied in the most perfect manner with little labour; and economically otherwise, for it may possibly be all repaid in the mutton made if the sheep have been well selected or well bought.

The data given on p. 33 will enable the calculation of the stock required upon the farm, in order to the consumption of the food provided. And the figures given are we think sufficiently liberal to hinder the employment of more stock than the food provided can maintain—than which a greater error cannot be committed. To be forced to sell because of being overstocked, or indeed for any cause whatever, is certain to end in loss. And it will always be better therefore to understock than to overstock your land. Calculating on the data already given, a crop of clover which will give

10 tons of green food between May and July should thus keep 10 sheep or more per acre during these 13 weeks. A crop of swedes weighing 20 tons per acre should keep 18 or 19 sheep per acre during 12 or 13 weeks—more, if other food be also given. A crop of grass yielding 15 to 17 tons of green stuff in the course of the summer should keep 2 cows per acre between May and October. This will be ample food for them during the early months, though not perhaps enough during the latter months. If the land is wholly grazing ground, it must be stocked more thickly in May and June than in September; or provision in the way of cabbages and vetches, &c., must be made as the grass is growing short. In practice the stock on the area of dairy ground is maintained or even increased in quantity as the months of summer go on; the food being kept proportioned to it by a large proportion of the grass of the early months being made into hay, the after-math of which becomes available to help the diminished yield of the remaining area during the latter months.

The kind of calculation which must be made may be illustrated by an example.

We will take the case of a 500 acre farm of a fairly substantial soil, one-fifth old grass—with the plough land cultivated for the most part on the four-course system—a certain amount of variation being adopted in the green crop half, so as to admit of a greater interval between the clover crops and a certain amount of catch cropping to meet the wants of what may be called difficult seasons of the year for the livestock on the farm. The table on the next page gives the quantity of food available month by month on the farm according to the scheme of cultivation described on the page after it.

CROPS.	Produce per Acre.	Acres.	Total Produce.	Consumption in Tons during the several Months.												Consumed as Hay.
				Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
	Tons.		Tons.													
(2.) *a.* Trifolium .	12	10	120	10	10	...	10	50	20	...	...	...	...	10	10	40
and Mustard	4	...	40	...	...	...	...	...	...	...	...	20	20	...	...	...
b. Vetches . .	8	10	80	...	...	...	...	30	50	...	...	...	...	...	..	...
and Turnips .	10	...	100	...	...	...	...	...	...	...	...	...	20	40	40	...
c. Rye . . .	8	10	80	...	...	...	20	60	...	...	...	...	...	...	...	...
and Turnips .	10	...	100	...	...	...	...	...	...	...	...	10	50	40	...	...
d. Mangel Wurzel	30	30	900	200	200	250	250	...	...	...	...	...	...	...	...	...
e. Swedes . .	18	30	540	80	80	40	...	...	...	...	...	...	...	120	220	...
f. Cabbages .	{ 10 / 20 }	10	300	...	...	...	...	...	20	50	40	50	80	60	...	...
4. Clover. . .	15	50	750	30	30	30	30	60	90	120	130	100	70	30	30	200
Permanent Grass	12	100	1200	20	20	20	20	150	180	180	220	200	150	20	20	200
Total . .	157	250	4210	340	340	340	330	350	360	350	390	380	390	320	320	440

The land referred to in the previous table has been cropped as follows:—

1.	Wheat	100 Acres
2.	Trifolium followed by late-sown turnips, or mustard	10 ,,
	Vetches do. do. do. do.	10 ,,
	Rye, followed by early-sown turnips	10 ,,
	Mangel Wurzel	30 ,,
	Swedish Turnips	30 ,,
	Cabbage, early and late	10 ,,
3.	Barley and Oats	100 ,,
4.	Clover	50 ,,
	Winter beans	50 ,,

The produce, so far as provision for livestock is concerned, which is the point under consideration now, will include straw, hay, and green food of various kinds. The straw will go only partly for food, chopped up and mixed with pulped roots and a certain amount of meal or cake. It will thus be a contribution to the feeding powers of the farm and must therefore be named: but it will mainly go as litter to the dung-heap. The hay will be calculated in the following table not as hay but as the green crop which it originally was, the months for its consumption being those in which the hay, into which that green crop has been converted, is eaten. The probable produce per acre is mentioned in the first column of the table, and in the subsequent columns corresponding to the months of the year we have stated the quantities available for each month from the several crops.

The produce according to this calculation comes out equal to 350 tons of green food a month more or less during the year, of which some 440 tons are given as hay—about 50 tons a month during 7 months of the year, a certain quantity being left for use during the summer. This is equal to 10 tons of hay, (=50 tons of green food) monthly during

the winter. It may also be necessary to explain, if any one shall work out this table for himself, that in July and August the after-maths of both clover and meadow come in to swell the quantity of green food in that form provided during those months.

The produce per acre is put higher than probably will on an average be obtained; but in assuming 28 lbs or thereabouts to be the daily consumption of green food by a full-grown sheep receiving nothing else, we are also going beyond the average truth, and the one error may correct the other. In fact all these calculations are the victims and the prey of circumstance. Seasons upset them, disease upsets them, accident upsets them. Agriculture is the most zig-zag of all occupations in its ordinary experience; and the results which come of figures, if the calculation has been accurate, generally exist in the mind of the experienced farmer as conclusions arrived at after years during which he has known every kind of lot on both sides of the average at which he has at length arrived. Such calculations must not however be disparaged on that account. A young farmer, especially, has more or less to depend on them for the provision which he determines to make for the future at the outset of each year. And the only caution we shall give him is to beware of over sanguine calculation, and of thus stocking his land with more than the food supply allows.

Let us now therefore see what stock the provision here assumed will enable us to keep. Supposing the average monthly supply to be 350 tons, we shall have some 20,000 lbs. of green food daily at our disposal. And this would maintain a flock of something less than 1000 full-grown sheep, equal to 2 sheep per acre, throughout the year.

But the farm according to the calculation already made will probably require 8 pairs of horses to work it; and there goes the food of at least 150 sheep. Considering the extent of permanent pasture, it may be well to keep a certain amount of cowstock, say 12 cows, of which the produce may be kept on till 2 or 3 years old, and then sold either fat or as heifers in calf, or with calves by their side. Some fat beasts would be sold before the 3rd year was out, but as the consuming power of other livestock—sheep especially—would be increasing as the months went on, the draught upon the food supply would be pretty uniform. There would be 12 of each of the ages, except perhaps the last, every winter in the yard: 12 cows corresponding to 120 sheep; 12 calves to, say, 24 sheep: 12 yearlings to 40 sheep; 12 two-year olds to 60 sheep; and, say, 6 three-year olds to 56 sheep. Here are a total of 450 sheep already written off the flock of 1000.

We do not pursue the calculation further in detail. It is probable that a flock of 300 or 350 ewes with their produce, sold perhaps partly as fat lamb and the remainder in the following spring as fat mutton, would, with the pig stock that might be kept, be enough to consume the remainder although it is calculated for the feeding of a flock of 550 sheep throughout the year.

We have said nothing here of purchased food. This may amount to £1 per acre, and does in some cases amount to more. Fifty tons or more, besides horse corn (equal to 100 quarters of oats in the year), say 65 tons altogether of corn and cake is equal to probably 1000 tons of green food and able with the proportion of straw that would be consumed, to keep a quarter more stock than has been calculated. We shall, however, be satisfied with having indicated the mode

in which such calculations must be made, and with having in this particular item as in others illustrated the looseness with which the results of such calculations must be held, with an especial view to the warning against over-stocking with which this section must conclude.

The **Implements** required on the farm are sufficiently enumerated in the examples given, in the previous chapter, in the cases of the light land Wiltshire farm and the heavier arable north country farms. There is an example too of dairy farming given—and an enumeration there. The implements of tillage are determined by the number of teams required —the "implements" of carriage to some extent depend on the distance of the market. The implements for preparing food depend on the mode of stocking adopted; and a good deal of special equipment under this head hinges on special cropping on the one hand and facilities for hiring machinery on the other. Thus where potato cultivation is largely adopted, the potato-digging machine will be purchased, and when thrashing machines, and sometimes even sowing machines, can be hired, the cost of providing machinery on small farms for these purposes may be avoided. The only economy we need refer to here is this possibility of hiring machinery whenever the farm is not large. Steam cultivators may be hired, and threshing machines are generally hired. The former may lead to a most useful economy of horse-power as well as of tillage implements, ploughs, and cultivators. Threshing machines are now able to turn out grain so perfectly fit for market, that the purchase of some of the otherwise necessary barn machinery may be also saved.

It may be useful here to point out that the machinery of

the farm is apt to be increased nowadays beyond reason; though it is excused by the constantly growing cost of manual labour. The economy of organizing and superintending that efficiently thus tells in two ways. Fewer hands are required; and some of the expense of labour-saving machinery may be dispensed with. Remembering how short a time ago it seems since the plough, the harrow, the grubber, the roller, and the cart or waggon were almost all the tools employed upon the land,—with flail and sieve and fanner for the barn, — the young farmer would, it appears to us, do well to be driven with difficulty in the direction of the elaborate machinery which is now to be seen on almost every farm. No doubt, however, harvest machinery of all kinds is an immense advantage, and, indeed, a necessity now that labourers are fewer, especially at that time, than they used to be.

In an appendix there is given a price-list of all the agricultural machines that can be required, compiled from recent catalogues of the Great Annual Agricultural Exhibitions.

CHAPTER III.

FARM CAPITAL.

Machinery.—Live-stock.—Food.—Seeds.—Manures.—Labour.—Rent.

THE Farm Capital includes (*a*) the machinery needed for the due management of the land; (*b*) the live stock, both horse-power, and cattle, sheep and pigs, with which to convert its produce into marketable form; and (*c*) such purchased additions to that produce as may be required in order to the conversion of the latter in the best and most profitable manner. It also includes (*d*) seeds of the various crops to be grown, by which the fertility of the soil is to be utilized; and (*e*) such purchased manures in addition as may be required, in order to the best and most economical use and developement of that natural fertility. It includes (*f*) the labour also of the year's proceedings before the produce is available for the provision of wages. Lastly, (*g*) it includes the year's rent and taxes. This, so far as rent is concerned, is in theory paid out of produce, and has not hitherto, perhaps, been considered a claim on the necessary capital of the farm. Where that idea obtains, the farmer and the landlord are partners in the business; and the individual rights on either side become obscure and mixed. But now that the law defines the tenant-right in precise and unevadable terms, we must consider the rent also to be a demand upon the farmer's capital.

He must have at his disposal the means of meeting all these requirements before he takes his farm. The rent and taxes may be so low as 20*s*., so high as £5 per acre. The labour bill may be so low as 10*s*. an acre on grass land, or even less on mere grazing ground, and it may be so high as £3 per acre. The manure bill may vary from £0 to, say, £1 an acre; indeed, even excluding market gardening from the view, the manure and labour bill sometimes exceeds even £10 an acre. The seed may cost nothing, as on a grass-land farm, or it may cost 10*s*. an acre all over the farm, as in the case of a farm wholly arable. The bill for purchased food is often £1 an acre, sometimes more, but of course it may be very much less according to the style of management adopted. We have already reached on the whole an alternative of 30*s*. on the one side, and (supposing all the maxima to come together) £10 10*s*. per acre on the other; and we have not yet even started our farm as it is called, *i.e.*, provided it with live stock and machinery.

The former may cost £3 an acre beside the horse-power, which, at a team for every 60 acres of arable land, may be £1 an acre on light arable land, or even £2 per acre on heavier soils. In our ideal farm of 500 acres we found food for at least 2 sheep per acre; and these may be supposed to cost £4; and if converted, as we imagined, into the maintenance of 16 horses, 12 cows, 12 calves, 12 yearlings, 12 2-year-old, 6 3-year-old, and 550 sheep, besides pigs, the total value can hardly be less than £2060, or £4 per acre, as already stated.

This is in the case of a fairly stocked farm of 500 acres of good arable land. Take the case of the best grazing grounds, where an ox and a sheep can be fattened per acre,

and the farm capital under this head may amount to £20 or more an acre. Lastly we come to the provision of machinery, and here again the necessities of the case vary between the widest extremes. A large arable farm with steam-power for cultivation, and for threshing, and for working food machinery—all of them probably separate engines—with the threshing machine, and elaborate machinery for cutting, chaffing, pulping, steaming, &c.; besides the ordinary supply of tillage implements and carriages—may cost £3 an acre for machinery. An ordinary farm, where much machinery of the costly sort may be hired, need not cost £1 an acre for its tools; and on a grazing farm, where hardly any machinery at all is needed, the cost is reduced to a minimum. We have given in an appendix the cost of the machines of the farm, and in the previous chapter there were examples given of the actual equipment of the land in these particulars on English and Scotch farms, so that the sum actually required in any case may be calculated.

The totals under implements and live stock thus reach amounts varying between £3 and £1, and £20 and £4, respectively; and the total farm capital, it will be seen, varies between the widest possible extremes.

In the case of Professor Wrightson's farm of 550 acres, at Downton, Wiltshire, it amounts to about £14 per acre. This is on a light land farm mostly arable. In the case of Mr. C. Randell's farm of 565 acres, at Chadbury, Evesdam, 390 being arable, and much of it being heavy land—all of it very laborious, and involving extra labour for some amount of market gardening—the capital is no less than £17 per acre.

We have not considered, as one of the divisions of the

capital required on entering a farm, the amount of the bill to be paid to the outgoing tenant. Its items are, for the most part, included in the statement already given of payments made for food and manure in the course of the year, and probably, so far as the current crops on the land are concerned, for seed and labour. Where there is a payment due to the outgoing tenant for increased fertility, that is a matter rather for the landlord than the farmer. It has to be paid for by one or the other; and if by the former, then the tenant will pay the higher rent which land in the improved condition commands, with the necessity, however, laid upon him of maintaining that condition; or, as he knows, it will be replaced at his expense by his successor. If the tenant takes the land at the old rent, himself paying for the extra condition in which he receives it, that indeed will be an increase of the amount of capital he will require. But if fairly valued to him, it will be the most profitable portion of his outlay.

It is necessary to add, that the general tendency of modern farming being towards the production of milk and meat rather than grain, a much larger capital will become necessary in the future than has hitherto sufficed for the due equipment of the farm.

In a series of instances in which this whole subject of the capital of the farm was examined many years ago, the sum required varied from £7 10*s.* per acre in the case of a dairy farm, to £17 per acre in the case of a small farm. The labour bill is now extraordinarily heavy: and the amount, taking the increased cost of rent and labour, tradesmen's bills, machinery, and livestock into consideration, will be from 10 to 30 per cent. higher.

In a paper on Farm Capital, by Mr. Elias P. Squarey in

the volume of the "Royal Agricultural Society's Journal" for 1878, several typical farms are considered. A dairy farm of 200 acres, at a rent of 50*s*. per acre, about one-sixth part being arable, is declared to require a capital of £12 an acre; a mixed arable and pasture farm of 500 acres, at 30*s*. an acre, is also assumed to require a capital of £12 an acre; a mixed and partly upland farm of 1000 acres, at 20*s*. an acre, requires a capital of £10 an acre; and a grazing farm of 300 acres, at a rent of £3 3*s*. an acre, is supposed to need a capital of £15 an acre. It is plain that the temptation will always be to take a farm larger than the capital at command can manage. That is the temptation, and the hope of good luck makes it often too strong to be resisted. Repentance, however, generally follows.

We might conclude our remarks on this subject, as we did many years ago, by drawing a comparison between two men of equal means, one taking a farm greater than he had capital for, and the other taking one well within his means, showing that, apart from the inevitable tardiness of all the operations of agriculture by the former, and the evil effects of that, the probability is, that the greater surface would be productive only of greater cost in the shape of rent and labour, not of a greater gross produce; but indeed, the smaller returns from a given farm capital, when spread insufficiently upon the land, are illustrated by all agricultural experience.

CHAPTER IV.

FARM ROADS.

Materials.—Specification.—Maintenance.—Tramways.

THE construction and maintenance of the occupation roads of the estate and farm, is a branch of engineering which comes within the scope of the land agent, and on which the economy of cultivation considerably depends.

Materials.—The cost of making roads depends on the facilities afforded by the different geological formations of a district; and the expense of maintenance is greatly influenced by the mean annual rainfall of the district. The formations which furnish the best materials are the granites, traps, and slates of Cornwall, Devon, Wales, Westmoreland and Cumberland,—the Silurian formations of Radnor, Carmarthen, Hereford, and Shropshire,—the flint-bearing chalks of some of the Southern Counties—the mountain limestones of Somerset, Gloucestershire, Derbyshire, and Yorkshire—the harder beds of the Oolite, which occupies a large stretch of the Midlands—and the gravel beds of the drift which are scattered over the whole of England. These last, where free from mixture of soil or clay, furnish suitable and durable materials wherever obtainable at moderate cost. The slag from smelting furnaces also forms occasionally a valuable material. Throughout the Oxford, Lias, Kimmeridge, and Wealden

clay formations clay ballast is largely used; it makes an excellent foundation, and even when used exclusively it forms a serviceable road for light traffic.

The duration of any material will be short where it is constantly saturated with moisture. Under such circumstances severe frosts will ultimately disintegrate the hardest materials. The average rainfall varies widely throughout the different districts of England; on the western and north-western the minimum is 30 inches, with a maximum of 140 inches, whilst on the eastern side the minimum is 20 and the maximum 33 inches. It is obvious that the cost of maintenance will vary materially in such very different circumstances of rainfall.

Specification.—The construction of new roads is frequently let to a contractor at a fixed price per chain, he finding labour, plant, and materials. Before a satisfactory contract can be arranged, plans and sections of culverts or bridges and a complete specification must be furnished. This requires a certain amount of engineering skill and a good practical knowledge of the work; and this a capable agent should be well able to bring to bear on the task. On large estates where a large body of men are constantly employed, with all the necessary plant required for the work of an estate, the work can be done not only better but at less cost than when let to a contractor, whose object is to complete the work expeditiously at the least possible cost to himself, so long as it will pass the inspector, or the agent whom the landlord employs. In no case should efficiency be sacrificed to parsimony; substantial and efficient construction is the great guarantee of future economy in the cost of maintenance.

The general and most serviceable width of farm or occupation roads, is 10 feet of metal, with a level grass margin of 4 feet on each side. The first operation is to stick a line of strong pegs, eighteen inches long or thereabouts, at half a chain distant along the centre of the proposed road. On each side five feet distant from the central peg a line is stretched and the ground nicked out. This operation must be performed by the operator keeping the back of his spade towards the grass margin; the spade being held so as to cut the soil at an angle of about 45 degrees. The section of the road when finished is of a somewhat convex form, rising six inches or thereabouts at the centre. On clay or bog soils, a most important point is thorough drainage: on strong adhesive clays a three-inch pipe drain not less than three feet deep must run longitudinally under the metal on each side the road. Where the soil is of a more open and porous character, a single drain four feet deep along the centre will be sufficient. These drains empty themselves into brick culverts or strong pipe drains, which cross the line of road at right angles wherever the land furnishes a natural outfall; otherwise the water must be conveyed by underground drainage to the nearest brook. In addition to these, an open carrier must be made on the outside of the grass margin on each side of the road; this carrier should be two feet in width at the top, fifteen inches deep, sloping on each side so as to leave a clear space of nine inches at bottom. On wet lands with flat gradients these side ditches are of great advantage, as they rapidly relieve the soil from surplus water after a heavy rainfall, which instead of being absorbed, is run off at once. The grass margins should be levelled or slightly sloped towards the carrier. If not already turfed, the surface should be thickly

sown with grasses suited to the soil and climate, and protected until the plants become well rooted so as to form a good sward. In some cases the side ditches are made close to the metal; the advantages of this plan are counterbalanced by certain obvious defects, the chief of which is that the traffic is constantly being interrupted by carts and other vehicles getting into the ditch. The grass margin saves the roads to some extent, being used by those on horseback.

On wet boggy or peaty soils we find it necessary to form a stable foundation for the ballast or metal. The best material for this purpose is a layer of hazel, blackthorn, or other underwood; or even the branches of the larch, Scotch fir, or oak will suit the purpose; whilst in hilly districts we have successfully used furze and heather. On strong clay soils, where stone or gravel is expensive and difficult to obtain, well-burnt clay ballast is a valuable substitute. When the drains are laid, side-ditches cut, and the road formed to the required curvature of section: a covering of from ten inches to a foot of clay ballast is then put on and rolled down with a heavy roller. Over this is placed a 3 to 6 inch coating of clean gravel, broken stone, or furnace slag, and it is again rolled. The clean pebbly gravel from the river-bed or sea-beach is a durable material. The chief objection to it is its water-worn polished surfaces, which prevent its cohesion: on the other hand, the broken stone or slags have angularities of surface which ensure a firm bond. It is well in a contract to specify not so many inches of depth, but so many cubic yards of ballast and of broken stone or gravel respectively (to be measured before removal) for every 10 or 20 yards of the length of the road to be made. A road 12 feet wide with 12 inches of ballast and 3 inches of broken stone will require 4 cubic yards of ballast and 1

cubic yard of broken stone for every yard in length. The present contract price for well-burnt clay ballast is 2*s*. per cubic yard. Under experienced and skilful management one ton of coal slack will burn five cubic yards of ballast. It is of great importance that the entire width between the side ditches should be free from undulations or slack places; to meet this difficulty we have a template constructed, consisting of a board 18 feet long, 16 inches deep, and one inch thick. This is hollowed out to the exact curvature of the road; it is carried on two small wheels eight inches in diameter; a light handle is attached to the centre, and is supported by wing braces. The use of this insures an even and correct surface.

Maintenance.—However skilfully the work may be completed the chief guarantee of success consists in keeping the road in repair. If neglected, deep ruts will soon be formed which retain the water, and this will in a short time render the road impassable. The repair of farm roads is a source of great anxiety to any agent who has an eye for order and economy. On large estates it is best for the landlord to take the management of the roads into his own hands, charging the occupant a fixed price per chain for the labour; any haulage that may be required, still being done by the tenant. The plan has its advantages and its defects; the work is better done by skilled men, and, on the other hand, the tenant, having less interest in the cost of repairs, may be less careful, particularly in wet weather.

In many districts farm roads are greatly injured by overhanging trees and high fences, which shut out the sunshine, and prevent free circulation of air, thus checking

evaporation: hence the utility of keeping road-side hedges low. The making and maintenance of occupation roads are an important branch of estate management, which deserves much greater attention than it usually obtains. We hope to see the young surveyor devote some of his energy to this important branch of his profession, which will well repay his study and attention.

It is only necessary to add that a good road connecting the homestead with the nearest public road is essential to the economical management of every farm. It should be at least 12 feet wide. And besides this, access should be had by good 10-foot roads to all arable fields: the lines of such roads being so laid out as to give this access by means of the most direct route, and therefore the shortest length.

Tramways.—Having had considerable experience in the reclamation and cultivation of peat land, we have found the use of a light portable railway with small trucks a very great convenience. Where the ground is level three or four of the loaded trucks can be pushed about by a couple of men, and manure can be spread from the trucks where required, and in the same way can be farm produce collected, and removed to sound land. This is a sort of road communication which might be advantageously extended to strong lands, both for manuring and for carrying the root crops. Under skilful culture the best of root crops can be grown on strong land; but under the usual system they can neither be consumed on the land, nor removed without great injury to the soil. By the use of such a portable railway they can be taken off, without injury, either to yards or dry fields for consumption.

CHAPTER V.

FIELD FENCES.

Turf.—Stone.—Dead-wood.—Post and Rail.—Wire.—Live fences.—Gates.

THE earliest fences required for the protection of our domesticated animals were erected from the materials most readily available on the land—stone, turf, and timber; and these have continued more or less in use up till now.

Turf.—In many parts of the country sod mounds—provincially, turf dykes—are still common. The method of construction is simple: the base is set out a width of three to four feet, according to the required height, that being generally four feet. On each side of the base the surface soil is cut into sods eight inches wide, eighteen inches long, and six inches deep; the first row is placed edgewise on the base with the grass side outwards, and the same on the opposite side; the space between is filled up with soil excavated from each side; and the outsides are built up as the work proceeds. The centre is well beaten or pounded; and each side is carried up with a slope of one horizontal to two vertical, finishing with a width of one foot or eighteen inches at the top. The sides are well beaten, and unless constructed in the heat of summer, the turf soon takes root, forming a serviceable fence for many years. For a fence four feet high, the surface of the land on each side requires to be removed a width of four feet,—six

separate sods, each eight inches wide. The excavation should gradually slope from the outside towards the base of the mound, and a portion of the upper soil should be reserved to dress the excavation, which should be sown with grass seeds, soon forming a sound sward. In some counties, as in Cheshire, the mound is seldom raised more than three feet, and a thorn or other live fence is planted on the top. The chief recommendation to the system there is that to some extent it protects the young plants from the attacks of cattle. In high and exposed districts turf banks are also useful as affording shelter to the stock. In such localities, whin or gorse seed is sometimes sown on the top of the bank; and this when carefully used and tended is useful for a time. But this plant is too short-lived to be of much practical value. Fences of this kind require a close supervision, in order to repair any breaches as soon as they occur; as, if neglected, they soon become ruinous. Such fences are only suited to high and exposed situations, and where the land is of little value.

Stone Walls are common on hill pastures, wherever the formation yields a stone easily quarried and of a durable character. The till or drift formation, particularly amongst the sheep-walks of the north, is full of boulder-stones of various sizes, which are frequently utilised for this purpose. Granite boulders can be cloven by a skilful hand as easily as billets of wood. In stone wall countries the requirements of the district have educated a race of skilled labourers, superior to the ordinary farm workmen. When executed by a skilful hand, a wall of this kind is a permanent structure. The best hands work to a line in the same way as a bricklayer; the stones are

carefully selected, the smaller ones are used in the foundation, dressed and laid to a fair face, rapidly narrowing from the foundation upwards, for two or three feet from the ground. At this point the width is from twenty inches to two feet: stones of sufficient length to reach from side to side of the wall, called by the workmen throughbonds, are now selected for preference; these should lie flat, thus binding the foundation. Over these are placed others in "random" courses, which lock together, making a substantial structure, finished with a roughly dressed coping placed on the top, sometimes set in mortar. When well constructed this makes a durable and serviceable fence. The high price of labour is, however, inducing landlords to try cheaper, though less durable materials.

Open Ditches.—On fen and bog lands open ditches are common; they serve the double purpose of a restraining barrier against the inroads of stock, an outflow for the surplus water with which the soil is charged, and in level fens a means of retaining water for the advantage of the land, and the use of the stock. Commonly, these ditches vary in width and depth with the natural contour of the land and the volume of water to be carried off. They are usually cut with a "batter" or slope of two to one. Having decided the requisite width of bottom to meet the special requirements and the depth of the cutting, the width at the top is easily calculated. The soil removed from the excavation should be spread over the land, except in such cases as require a bank, which should then be placed some distance from the face of the slope, otherwise the additional pressure endangers the stability of the cutting by causing the sides to slip. Ditches, where leading to a brook or

other active watercourse, materially contribute to fertility, by their use as drains. And the filling up field ditches, which was recommended when underground drainage was first practised, and which was largely carried out many years ago, has since been found bad policy.

Dead Fences.—These are of various kinds, depending to some extent on the materials at command. In woodland districts where underwood is plentiful and of small value, a most useful and a tolerably durable fence can be constructed at a moderate cost. The best material is mixed underwood of from 8 to 12 years' growth; hazel, black willow, ash suckers, birch, alder, or blackthorn are the most suitable. The wood must be cut before the sap begins to flow,—the strongest are selected for stakes; these do not exceed 3 inches in diameter at the butt end or 1½ to 2 inches at the top. They are cut in lengths of 4 feet 6 inches. Shaped to a point at the thick end, with the hatchet, the line of fence is ranged on the ground by setting up sighting poles; holes are made with an iron crowbar 2 feet apart along the line, and the stakes driven home to a sufficient depth—12 inches or more. These form the framework; the materials are then woven in—basket fashion; the straightest and most pliable of a uniform thickness being carefully selected, trimmed, and used as binders. The stability and neat finish of the work is due in great measure to the skill displayed in the binding; when skilfully executed it forms a selvage equally adapted to its special purpose as is that of the weaver's art. The sides are trimmed free of loose ends with a hook or light hand-chopper. The tops of the stakes are all cut of a uniform height about two inches above the binders; this

is cleverly accomplished by the hedger, who selects a round piece of wood about 3 inches in diameter and 2 feet long. Grasping one end with his left hand, he places it sideways against the head of the stakes whilst with his right hand he wields a hand bill, one blow from which severs the top of the stake. The blow is delivered in a sloping direction with an angle of about 45 degrees: every stake is cut from the same side; and this not only gives a finished appearance to the work but it also allows the rain to run off, which would otherwise soak into the wood, inducing premature decay. When finished, the height of the fence is usually about $3\frac{1}{2}$ feet, and with present prices the cost of making it is 2*s*. 6*d*. per chain; and when well made from good materials it will last from 6 to 8 years. There is no better protection for the rearing of live fences. When placed on either side they form both a shelter and protection from the inroads of game and other vermin. Another description of dead fence is made of thorns. A narrow rut is cut in the soil, the thorns placed on end and the soil firmly rammed in on each side, and the top is chopped off level. This is only of a very temporary character, and of little use except against sheep.

Post and Rail.—Oak posts and larch rails make a serviceable fence against all kinds of stock; but the scarcity of the material on most estates has interfered with its adoption. The most durable kind of post and rail fence is composed of oak posts and cleft oak-rails; when skilfully constructed a fence of this kind will last from 12 to 15 years. At the present time the cheapest wooden fence is creosoted pitch-pine posts and rails. For permanent enclosures, such as fences round deer parks, pitch pine paling—5ft. 6in.

high, costing 4*s.* 6*d.* per yard—is both durable and efficient. Where appearance is of importance upright paling is frequently used, the strength of the material being regulated in accordance with the height of the fence, and the kind of stock to be restrained. For a fence 5 feet high the posts should be 4 inches square let into the ground not less than 3 feet; and placed 9 feet apart. Two triangular rails 4in. by 2in., are housed into these posts. The rails are so placed as to divide the length of the pale into three equal parts; the tops of the pales may be rounded or pointed off. They should not be more than 3 inches wide, securely nailed to the cross rails. The space between each pair should be equal to the width of the pale.

Wire Fencing is another useful and cheap form of fencing rapidly coming into public favour both at home and in the colonies, many miles being erected every year. At first common iron wire was used. Wooden stakes were driven into the ground at fixed distances, and the wire was strained; and then secured to these by small staples. This method has long since been superseded. In erecting a wire fence the first operation is to fix standing posts at a distance of 220 yards apart; these are usually constructed of iron, through wood will equally answer the purpose; the chief objection to it being its limited durability. The old system of winding by ratchet and pawl has been discarded on account of its complication and cost. Intermediate uprights are placed along the line 6 feet apart; these are sometimes made of two thicknesses of galvanised sheet iron riveted together, forming a boss in the centre and tapering from the bottom to the top; the uprights are securely fixed in the ground. A wire fence for general

purposes should be 3 feet 2 inches from the surface of the ground to the top wire, the second wire is 2 feet 6 inches from the ground, third 1 foot 10 inches, fourth 1 foot 4½ inches, fifth 11 inches, sixth 6 inches. Less than six separate strands cannot be recommended.

A new and improved method of fixing wire fencing is now coming into general use. Permanent T iron standards are placed 22 yards apart, along the line of fence; holes are drilled at correct distances to receive the wires. These standards are sharpened and driven into the ground with a maul to the depth of 18 inches; a round piece of wood 16 inches long and 4 inches in diameter, having a slot in the centre of sufficient width to pass the standard, is passed over the top and dropped down; a nick of sufficient width and length is made in the soil to a depth of 8 inches, where the billet is let in; a hole to admit a collar is drilled in the standard which prevents the billet from shifting upwards, and firmly secures the standard; a side stay is bolted to the top and secured in the ground in the same way. These stays are of ¾ inch round iron, the permanent standards are 1½ inch wrought iron. When perfectly strained and secured no farther support is necessary for the wires except to prevent them being pressed apart, which sheep and other stock would readily do, and pass between. To obviate this, flat pieces of wood called droppers are used; these may be of any hard wood, oak, ash, or larch 2½ by ⅞ inches, and 3 feet 3 inches long. Holes are bored in these at corresponding distances to those in the permanent standards, the wires are passed through, and wedged in order to keep the droppers in position, their bottom ends merely resting on the ground. These droppers are placed at a distance of 2 feet 4 inches apart. It is

amusing to see the effect of such a fence when charged by any heavy animal. Giving way to a certain extent it suddenly recoils, generally hurling the animal to a considerable distance. For hill pastures wire fences are invaluable.

The neat appearance and moderate cost of iron fencing, and the great facility it affords for speedy erection and removal if necessary, has greatly extended its use. A common labourer of ordinary intelligence can, after a short practice and some general instructions, set up a fence with tolerable correctness. The strength, and consequently the cost, varies with the purposes for which it is intended. Great improvements have been made in the manufacture of this kind of fencing within the past few years. The uprights are constructed with feet calculated to resist the greatest amount of pressure with the least possible quantity of material. The bars are either made flat or round, and sometimes the uppermost is round and lower ones flat. When skilfully set up and neatly painted the fence looks well and is good for temporary purposes. Iron hurdles are also in very general use; having the advantage that they can readily be shifted as occasion may require. Long iron hurdles standing on wheels linked to one another are sometimes seen in 100 yard lengths.

Live Fences.—These are of various kinds, the chief of which are the hawthorn, beech, holly, blackthorn, privet, and whin or gorse. The beech is chiefly used about garden and home grounds, more on account of its ornamental character than for its merits as a fence. On suitable soils it bears cutting, and carries its leaves until they are supplanted by a new growth; and, well-trained, it makes a serviceable and durable fence. It thrives best on a deep,

retentive soil, partially shaded from the fierce rays of the sun. The holly bears trimming well, and requires a deep dry loam to mature on damp low-lying soils. It is not always long-lived; long-continued and severe frosts frequently prove fatal to it. It also suffers much from ground game, rabbits being amongst its most deadly enemies. Privet is only an ornamental apology for a fence, useless against the attacks of heavy stock.

For general purposes and under all circumstances of soil and climate, the haw or white thorn is unsurpassed. Its natural habitat is a deep warm loam at a moderate elevation. At the same time it struggles on with varying degrees of success on every variety of soil, provided its roots be kept free from stagnant water. It is unnecessary here to enter into all the details of collecting the haws and raising the young plants; this is usually left to the care of the nurseryman. On the care and attention bestowed on them chiefly depends the success of the future plants. In order to encourage root-growth they should be removed and replanted every year. They are ready for removing from the nursery at from 3 to 5 years old. Those of the latter age are generally used for filling up blanks in old hedges. When well-grown, 3-year old quicks are the best for forming young hedges.

The first point to consider is the character of the soil and climate, especially as to the rainfall. On undrained soils in a wet district it is safest to cut a ditch, forming a mound with the excavated materials. The line of fence is first staked out; the ditch is lined off, this may be from 3 feet to 3 feet 6 inches at the surface, battering on both sides to 1 foot at the bottom. The first sod is cut about 9 inches wide, and neatly turned over on the whole ground, turf side downwards, leaving a clear space of 3 inches between the

turf and the face of the ditch; this prevents the soil from crumbling away and leaving the roots of the plants exposed at a later stage of their growth. The first row of sods are dressed off to a uniform depth, and on these the young plants are placed horizontally 4 inches apart; the soil is then excavated from the ditch, forming a mound on the plants. The face of the mound is dressed off at the same angle as that of the ditch, and neatly rounded at the back and top. Sometimes the stem of the young plant is cut off in a slanting direction near the root, leaving the ends of the stems slightly projecting beyond the face of the mound: but a moment's reflection will convince the most casual observer of the injurious effects such treatment has on the future growth of the plant.

We never cut off the stems until the second year, and then only when the wood has been fully ripened. The stems are cut off by a pair of shears specially constructed for the purpose; care being taken not to bruise or lacerate the bark. The plant requires constant attention during the earlier stages of its growth. An important point is careful protection from the inroads of stock and ground-game: and it is essential that the young plants should be kept free both from weeds and from long grass. When three years old, they are switched with a light hand-bill. For hedges of this kind the best form for the fence to assume is that of a ridge, the sides flat and tapering to a sharp roof-line—every part of the surface being thus exposed to the zenith. In this way they suffer less from a heavy fall of snow than when round or flat on the top. If the soil and climate be favourable, they will be sufficient for a sheep fence by the end of the eighth year. Sheep are most destructive to young quickset

hedges, both by their eating off the young shoots, and by their rubbing and leaving portions of their wool attached to the leaves and branches. Fences planted in this way, if neglected, form long bare stems open at the bottom, through which sheep push their way. The best plan of renovating such fences is to cut the stems within six inches of the ground; the cut should be made in a sloping direction and with a smooth face, to prevent the lodgment of moisture. Each stem then throws out numerous suckers, and these in a short time grow into an impenetrable mass.

Quicks are sometimes planted on the top of a mound, faced on each side with sods and filled up in the centre with soil; the only advantage is the protection they thus receive from stock during their early stages. In moist climates they thrive well whilst young: but the roots are cramped and they suffer from lack of moisture; hence fences planted in this way are generally short-lived.

By far the best system of planting whitethorn fences is on the flat. The line of fence is ranged, and a strip three feet wide set out and dug up to a depth of eighteen to twenty inches. If the soil is a lumpy clay or a weak sand, we prefer keeping the active soil near the surface, the subsoil being loosened by a fork without bringing it to the surface. The turf is turned in, leaving a mellow surface. Where farm-yard manure can be obtained a good dressing may be dug in; and on stiff soils lime can be used with advantage. The soil is benefited by being dug up during the early winter months, and exposed to the weather till the planting season arrives. The best time for planting is from early in March to the middle of April. A line is then stretched four inches on one side the centre of the prepared ground which should then be firmly trodden

along the line. The operator with spade in hand opens a narrow rut six or eight inches deep. The spade is thrust with its back to the line, making the opening on the outside. The plants are then placed in position perfectly upright with the stem resting against the solid soil under the line. The plants are placed eight inches apart. Great care should be taken to spread out the roots of each plant before covering them with soil, otherwise they are cramped and cankered, and the growth of the plants is retarded. The thin ends of the roots may be trimmed off with a sharp knife. The soil is returned and firmly trodden round the roots and neck of the plants. Care must be taken not to place them too deeply in the ground. When a length has been planted the line is removed to the opposite side, and again 4 in. from the centre; when the former operation is repeated, thus forming a double row. It should be so arranged that each plant in the second row should stand directly opposite the centre between each two of the opposite row. Practically this is superior to a single row, as greater space is afforded for cleaning—an important matter as regards the health and progress of the plants. The stems are cut off close to the ground. This should be done early in the spring before the sap becomes active, the roots having by this time become established. Each stem sends out a number of vigorous suckers; these are often more numerous than the roots can support in a healthy state. During the winter a careful man should be told off to thin out the weaker shoots, which will greatly increase the rapid development of those that are left.

Any attempt at raising a quick fence planted on the surface of the land, will end in utter disappointment unless

efficient means are used for its protection from stock or ground game. Various devices are used for the purpose; the stake-hedge already described is amongst the most efficient; unfortunately circumstances frequently preclude its use. The improved wire fence to which we have already referred, is the most readily available; and where ground game is numerous, wire netting must be used. Another important point is to keep the young plants free from weeds; except this is attended to, the stems grow bare of side branches at the bottom, which greatly detracts from the value of the fence. After the first year the fence should be trimmed with a light bill, the cuts being made by an upright stroke of a sharp tool. When kept free from weeds, and the cutting carefully attended to, a thick strong serviceable fence will soon spring up. The operation of cutting should never be performed until the wood has become fully ripe, otherwise the shoots die back, and the result is a weak growth the next year. Hedges that have been neglected during their earlier stages are best renovated by cutting and laying. The method we have described, of planting a double row of quick is particularly adapted to this purpose. When the cutting and laying is skilfully performed, with one line laid to the right hand, and the other to the left, it forms an impenetrable barrier against all kinds of stock. In laying a fence we prefer living to dead stakes, particularly in young fences, where there is generally plenty of wood. The great objection to the laying of young fences is that the stems are inevitably split down to the crown; this forms a receptacle for rain and moisture, and tends to shorten the life of the plants.

Where however hedges are skilfully managed, cutting

and laying is quite unnecessary: and landlords are blind to their own interests who do not employ a skilful hedger to manage the hedges on their estates. In the case of old and neglected hedges, the only means of renovation is by cutting and laying. Many hedges of this kind are gappy, the original plants having died out. The gaps should be carefully dug over, and all weeds and decaying roots forked out; if practicable some fresh soil should be put in, and some strong well-rooted 4 or 5 year old quicks planted and well guarded on both sides to prevent injury by stock. Unless the work is carefully done it seldom succeeds. Popular opinion avers that the soil, having become exhausted of the constituents necessary to the healthy growth of the plants, requires rest and amelioration before a second growth can succeed. But the failure may more frequently be traced to inattention in cleaning and cutting at suitable seasons. In laying old hedges we give the preference to dead stakes, in fact, in many instances the old living stems have become too bulky for the purpose. Part of the wood is entirely cut off; in this case the cut should be upwards, leaving a clean, smooth face; the layers are crippled near the root in order to enable the hedger to place them horizontally. These when laid should be notched in several places to encourage the growth of fresh shoots.

Well kept hedges are both useful and ornamental; they are a great source of comfort and security to the occupier.

Gates.—The usual five-barred field gate—hanging from upper and lower hinges on a post about 8 inches by 6 inches in section, and latched on to a post at the other end, about 6 inches square—is generally about 9½

feet long and 4 feet 3 inches high to the top line of its upper bar. The posts should be 8 feet long and fixed firmly 3 feet deep in their position. The gate consists of 5 horizontal bars housed into two upright end pieces—the one at the hinge end being 5 inches by 3—and that at the latch end about 3 inches by $2\frac{1}{2}$. The bars themselves are 3-inch strips of inch boarding, except the top one, which is of the same thickness as the uprights at the ends, and 5 inches deep at the hinge end and 3 inches deep at the latch end. There are two upright strips nailed on the 4 lower bars and housed into the top one at distances of 2 and 4 feet respectively from the latch end of the gate. And there is a piece of inch board 3 inches wide, extending from the housing of the lower bar at its hinge end to a point about 5 feet from that end in the upper bar, and nailed into all the horizontal bars as it crosses them—thus stiffening the whole framewrok. Or the stiffening may be still more effectually secured by two obliquely transverse strips nailed on one side of the gate to the upper ends of the two uprights and meeting in the middle of the lower horizontal bar—crossed by a corresponding but inverted V on the other side—the whole nailed and bolted together. The whole of the woodwork, posts and bars, should be heart of oak. The hinge irons should be substantially made, and the upper one may be constructed to embrace the upright and upper horizontal bar for some 18 inches of its length: being fastened in its place by through bolts. And the gate should hang so that it shuts flat against the receiving post and perfectly parallel with it.

The latch holding the gate closed is either an upright spring falling into a notched iron in the post, or it may be a hooked latch which takes hold of a staple in the post and is

provided with a loosely hinged T-piece at its extremity which once passed through the staple hangs horizontally and cannot be withdrawn except by a somewhat skilful manipulation; beyond the ability of even the cleverest of fence-breaking ponies.

Now that steam-engines and threshing-machines and steam-ploughs find their way into our fields, a gate of more than 9½ feet length is required; and the 11-foot gate which has become necessary is better made in two parts, each half 5½ feet long, hanging to its post and meeting on a stud in the ground midway between the posts, to which they can be fixed by a bolt dropping into a slot, or a catch holding on to a staple; and, above, the two end uprights can be held together by a ferule hinging on one and dropping over the other. In this case 6-inch posts are sufficient, and the dimensions generally may be reduced. Outside yard-gates should be boarded over properly constructed frames, hinging flush with the outside wall, so that they can be opened outwards, flat against the wall; and there should always be a catch fixed in the wall at the proper place to hold it open while constant cart-work is proceeding, as during the removal of manure. Gates in the inner dividing fences of large yards should be hung high enough to allow of being opened to and fro when the yard is full of manure.

In the Appendix will be found further specifications relating to this subject.

CHAPTER VI.

THE WATER SUPPLY.

Cottages—Farm Houses—Homesteads—Field Ponds.

Country places are generally worse off than towns for a supply of good water. The Rivers Pollution Commissioners illustrated this in one of their reports by the description, often true, of the way in which detached cottages are supplied. The house is built on 20 perches of land, and two holes are dug not 5 yards apart; into one all the filthy waste of every kind is discharged, and out of the other the daily provision of water is obtained! Farm-houses also often suffer from unwholesome water. A well is dug, perhaps 20 feet deep, in the backyard close to the cattle courts. By-and-by the well-digger comes upon what he calls a beautiful spring, which only means that he has got below the level at which water stands in the adjoining rock. That water was originally rain, and it has trickled downwards through the dung court close by, getting filtered and oxidised no doubt in its passage, so that as drawn it is clear, and probably all the sharper and pleasanter for the oxidised animal matter which it contains; but it is certainly liable to pollution of a very offensive kind. There are instances where the slops from the sick chamber thrown out thus obtained entrance to such a well; the water of which has been used to cleanse the milk cans; and the poison conveyed in this way has been disseminated in the neighbouring town.

Typhoid fever has thus been spread on several occasions in London; and of course the same liability affects the milk consumer on the farm itself. And the health of the live-stock of the farm, as well as of the families resident upon it, is in risk of suffering. The water supply to a farm is of great importance; and the position of the farm-house and of the farm homestead will often properly be determined by the facilities for a good water supply. And field ponds, where there are no field or fence-side rivulets or springs, are as necessary in the pastures as wells and tanks are for the homestead.

Throughout the dairy districts the recent change from cheese-making to milk-selling has considerably increased the strain on the water supply, as the temperature of all milk sent by rail must be reduced to about 58° Fahrenheit; and thus large quantities of cold water are required for use in the refrigerator. In the upland districts of Derbyshire, Staffordshire, and Cheshire, we have in many cases laid on an unfailing supply of pure water to homesteads at a trifling cost. The first point to ascertain is an unfailing source of supply; this is sometimes obtained by the interception of part of the water of a streamlet, if springs of sufficient volume cannot be found. In the former case a filter bed, six feet long, four feet wide, and three feet deep made water-tight, can be built of concrete, and the walls skimmed inside with cement. It should either be arched over, leaving a twenty-inch square opening in the centre, or be covered with rough stone flags. The top should be slightly below the bed of the stream or source of supply. The water is admitted through an orifice in the bottom of the tank, rising through a series of layers of gravel and charcoal. The outlet may be somewhat below the top of

the tank, and the orifice guarded by a perforated brass plate, to which a three-quarter-inch galvanised pipe is attached. This is sufficient for the ordinary requirements of a farmyard. Where there is a constant supply and a sufficient head storage, tanks are unnecessary at the homestead. In many localities it is impracticable to obtain a supply by gravitation, and then it may be possible to utilise the small fall of some stream or rivulet to propel a ram or turbine. The former is inexpensive in its action, and can be worked with a small fall, even in almost level districts. The artificial ponds or lakes in the park will thus sometimes furnish the means of supplying both the mansion and homestead with water. Of all water engines with which we are acquainted, the turbine is the most successful. Whether used on a large or a small scale, it will work with a very small head of water and a slight fall. Where a sufficient supply is available, it is the most economical and efficient prime mover at present in use, whether for pumping the water supply or for driving the ordinary machinery of the farm.

The Sanitary Act which applies to rural districts will soon banish from the farmyard the old drinking-pond, into which the storm-waters from the roofs and roads, and the diluted urine from the manure heap, and the slops from the scullery and kitchen flowed. Wherever live stock are thus supplied, no better illustration of the force of habit could possibly be adduced than is seen in the eagerness with which the domestic animals, when released from their stalls, slake their thirst with apparent relish. Although no ill effects are immediately apparent, nevertheless the cattle are thus rendered more susceptible to attacks of blood poisoning and other kindred ailments, to which they

sometimes succumb. Unlike solid food, liquids are at once absorbed, passing direct into the circulation; hence the water has a more or less effect on the quality of the milk.

Drinking ponds.—The formation of drinking ponds is pretty much the same, whatever the soil may be. They are usually of a circular or quadrangular shape, the latter for preference; for moderately sized fields, a width of eighteen to twenty-one feet will be sufficient. The better plan is to commence the excavation at the lowest lip of the future pond, with a slope for the first three yards of one vertical to four horizontal, and for the next two yards, one vertical to three horizontal; this will give a depth of six feet at the lowest. The best material is a layer of well made concrete, consisting of hydraulic lime and broken stone, of from nine to sixteen inches thick, according to the nature of the soil. This is spread over the surface of the excavation, and the top surface is finished with a layer of fine stuff. When carefully prepared it sets immediately, and is perfectly impervious to water, and is little disturbed by the hoofs of stock which come to drink. To prevent the fraying and wearing away of the edge of the concrete on the side used by the cattle, a stone curb 16 inches deep and 4 inches thick should be firmly bedded in the soil, the top of which should be level with the land. The inner side forms a ground for the concrete, and insures a strong and durable job. The sides as well as the bottom of the pond, must be made impervious to water by a facing of stone or brick set in cement, or hydraulic lime, or it may be faced with nine to fifteen inches of concrete; this is best done after the bottom of the pond has been covered. A foundation for the side walls is necessary; this should be sixteen

inches below the level of the pond, and filled in with concrete. If a facing of brick or stone be thought desirable, it should not be less than nine inches thick, flushed in with cement or hydraulic mortar. We have successfully used concrete for this purpose: a rough framework is used to keep the concrete in a vertical position until it becomes solidified. At distances of three feet apart on the bottom level a dovetailed recess is cut in the face of the bank, and filled in with concrete; as the work proceeds these form buttresses which secure the wall in an upright position. When finished the top should be protected by a covering of soil, and securely fenced on three sides. Shade is of some importance, as it retards evaporation; at the same time, it is a mistake to plant trees too close to the pond. When full grown and clothed with foliage, they form a powerful leverage on which the wind acts, causing the banks to slip and crumble away.

In clay districts a less costly drinking pond is made by merely fashioning out the cavity, of the requisite dimensions and depth, in the hardened subsoil; thereafter laying 6 inches of puddled clay upon it; then flagging roughly with any flat stones, jointing these with mortar containing cement; afterwards causewaying it with stones on edge from 6 to 8 inches deep. This makes a very permanent job—and when made four-square at the corner junction of 4 fields the angles should be in the lines of the fence, and these continued into the midst of the pond, which thus provides a water supply to four fields. The drainage of the field may be conducted into the pond; and provision for carrying off the overflow should be made.

CHAPTER VII.

THE FARM HOMESTEAD.

Farmhouse—The Dairy—Cottages—Farm Buildings—Stable—Cowhouse—Piggery—Sheep-Yard—Waggon-Shed—Barns and Food Stores—Grains Pits—Silos—Further details—Materials—Conclusions.

THE homestead comprises buildings needed for housing the farmer and his family, and the labourers employed on the land; also for sheltering the various kinds of stock, and the implements of the farm; storage for grain and other produce; and places for preparing food for the stock. In erecting an entirely new steading, the first point to consider is the site. If it be a tillage or mixed farm, the spot chosen should be as near the centre of the occupation as practicable. The means of obtaining a constant supply of water should be a leading consideration. The necessary roads may be made and plantations may be formed, which grow up and afford either shelter or shade, after a site has on other grounds been selected; but without a supply of pure water, which is generally dependent on a natural source, the stock of the farm cannot be maintained in a healthy state. This, therefore, will often prove to be the ruling consideration in the determination of a site.

The buildings should be so arranged that the labour required in attendance shall be reduced to the minimum. The designer should also be conversant with the quality and value of materials, and the best methods of carrying out

the structural details; qualifications which can only be attained by observation and experience. And before finally deciding upon the plans, it is essential that the effects of local influences as affecting the permanent character of the farming be well weighed. The quality of the land, and whether it is old pasture, or tillage, or a mixed occupation; the general character of the climate; the distance from railways and good markets:—All these points should be carefully considered, as they indicate the system of cultivation most likely to be profitably pursued. Large sums have frequently been spent on buildings totally unsuited to the locality: natural influences have been completely ignored; the only consideration appearing to have been the gratification of a whim of the passing moment. On the best class of grazing lands the area under tillage is very limited, hence the accommodation required for stock is small; it is on the mixed tillage and pasture farms where the requirements are the greatest.

To thoroughly equip a large estate with modern buildings entails a large expenditure of capital, and cannot be effected, even by a rich man, without considerable self-denial: and the power of a tenant for life to charge his estate by means of a rent-charge, for a series of years, with the cost of buildings, and of other permanent improvements is a facility afforded by the Land Improvement Acts, which is of the greatest agricultural importance.

The Farmhouse.—The accommodation for the farmer and his family demands our first consideration. In ordinary cases the size of the house is regulated by the extent of the farm. In the designing and erection of the farmhouses intended as permanent structures it is best to keep some-

what in advance in the date, in order to meet the probable requirements of the future.

The social position of the tenant-farmer is very different from that of his forefathers. The large farmer is now a capitalist and an educated man, and, as such, expects attention to the comforts and amenities of life. During the severe agricultural depression there has been far less difficulty in letting farms where the homestead is modern and convenient than where it is inconvenient and dilapidated. The past twenty years have seen a vast improvement in the home of the tenant-farmer.

In the larger and better classes of farmhouses the accommodation required consists of three rooms, hall-passage, kitchen, pantry, and scullery on the ground floor, with good cellar below, and at least five or six bedrooms above. We need not, however, discuss the accommodation afforded in the farmhouse so far as ordinary domestic requirements are concerned. But it may be noted that a certain largeness of space as to passages, kitchen, cellars, and outhouses is required in farmhouses beyond what in ordinary house accommodation is expected.

Throughout the greater part of England bricks are now the chief materials used in the erection of farm homesteads. Recent improvements in brick-making machinery have not only lessened the cost, they have also greatly improved the quality of the bricks. Even in districts where stone is plentiful, the enhanced cost of getting and preparing it is to a great extent precluding its use.

The Dairy.—This is a necessary adjunct to the farmhouse: and, if detached, it should communicate with the house by a covered way. The dairy, to be satisfactory,

must consist of three separate apartments; the walls should be 14 inches thick—a double wall with central space crossed by wrought iron ties a yard apart in every third course of bricks. The floor of the dairy proper, or milk-room, should be at least 3 feet below the level of the rest of the building. Ventilation should be efficient and controllable, and the cold air admitted only on the floor line; a funnel or pipe should be fixed in the centre of the roof, to allow of the escape of heated air. The cleanest and most durable floor is Val de Travers asphalte. It should slope slightly to one side, where an outlet pipe is provided to carry off the water used in washing the floor. A shelf or bench, about 20 inches wide, is carried round the room, on which are set the milk pans. It is essential to have a good supply of water at command, and a service of pipes so arranged that they may be utilised either for lowering or raising the temperature. For the former, cold water would alone be used, whilst for the latter a circulation of hot water is obtained by a connection with the boiler in the scullery. Cleanliness is of the greatest importance; for milk is a ready "host" for the reception and development of the germs of decay. The windows are best placed on the north side of the building; a verandah should be carried round the outside, in order to ward off the direct rays of the sun. The churning and butter room is fitted up with polished slate shelves; the inside of the walls is either painted in oils or cased with glazed tiles—the latter preferable, as being both durable and easily kept clean.

The scullery is fitted with a large copper for supplying hot water. All the roofs should be lined inside with ½-inch match-boarding, over which is a layer of roofing-felt placed under the slates. It is essential that an unfailing supply

of water should be laid on to meet the requirements of the different departments.

Cottages.—It is true economy to provide cottage accommodation on a farm. When the labourer lives in a distant village a great part of his strength is wasted before he takes his tools in hand, and it is only a remainder that he has at his command. In Cornwall the labourer has in some mines to go 100 fathoms deep to the place of his labour, and he must retain the power to climb 100 fathoms high when he leaves it. He can thus afford to give but a small price per ton for the ore which is allotted to him. In Cornwall the miner represents the occupying tenant and labourer in one. When the man-engine was invented and applied, by which the labourer is lifted from his work, and taken to it, without personal exertion, the value of the ore was raised 30 per cent. at once. The Scottish farmer, with cottages upon his farm, has that "man-engine" in full operation, of which the English farmer, whose labourer comes sometimes 3 miles from the nearest village to his work, feels the want; and, no doubt, he very materially suffers from that want.

Cottages — sufficient at least to house the principal labourers employed on the farm—are therefore a necessity, except in peculiar cases adjacent to towns or villages. Under ordinary circumstances, one cottage for each 100 acres of land is the lowest practical limit. Cottages for agricultural labourers are generally erected in pairs. Though more pleasing to the eye when single or at most double, they are more costly than if erected in blocks of four or more. The provision of gardens, and the seclusion and independence of the cottager's family are,

however, best attained when cottages are built not more than two together. Speculative builders, who erect nearly all the houses occupied in villages by the working classes, can often satisfy the requirements of the Building Act, and pass the sanitary inspector, at a total cost of £130 per house, including the fee simple of the land. We have never succeeded in building a pair of full-sized labourers' cottages, with three bedrooms each, with coal-house and privy, for less than £240, not including the land, and charging labour and materials at prime cost. The price now allowed by the Land Commissioners to be charged on an estate for cottages, is £400 per pair; and it is seldom that the price under their specifications can be brought much lower. On large farms, where a number of cottages are necessary, it is well to have a few with two bedrooms only; these are suitable for newly-married couples, or for those whose families have gone out into the world.

Those who read Mr. Strickland's valuable report upon the cottage competition at Leeds on the occasion of the Royal Agricultural Society's meeting there in 1861, will find that the best arrangement involves in every case a living-room, scullery, and pantry, on the ground-floor, and three bedrooms above. In the Kirtlington cottages one of the bedrooms is on the ground-floor, and there are only two on the upper floor. The scullery is in a lean-to at the back of the house. This cottage, so far as the double-storied part of the house is concerned, thus includes two rooms below and two above. The upper bedrooms ventilate into a staircase passage, which is between them and is open to the roof. It must be admitted that there is an advantage in having one bedroom on the ground-floor—enabling a

young couple to keep the old people at home, who are thus made useful in taking care of the children, and at the same time are themselves cared for by their own family. The ground-floor bedroom is also especially useful in the case of an invalid, who can be tended with less labour, and with more constant watching and attention. Each block of two cottages has an out-house, comprising an oven and bake-house in common; they have also separate privies and ash-pits, &c.

This is in accordance with the recommendations on the whole subject of the writer of a prize essay on "Labourers' Cottages."*

Semi-detached cottages are to be preferred. Each should have a garden from a sixth to a quarter of an acre. The privy should be away from the water supply; and if there be a cesspool, it should be at the extreme end of the garden: if a pigsty, it should be away from the house. Tiles or slates, not thatch, should be used for the roof. And it may be mentioned, as affecting health, that the privy should be without any sunken cesspit. Any one using it goes up three steps (brick-work) to the seat; and thus the floor of the cesspit is on the level of the ground. It is laid in cement, and continued outwards beyond the wall under a flat archway behind, joining a cement floor outside, on which earth is laid, temporarily blocking up the arch-way in question, and ultimately used to mix with the filth and form a manure for the garden, which must be carried and dug in every week or fortnight.

There ought to be two doors to the lower rooms of the cottage, front and back. The windows and all sashes and

* Jarrold & Sons, 12, Paternoster Row.

casements should open near to the ceilings. Three bedrooms are needed for a family; viz., one for the parents, and one each for the boys and girls; fire places in two and all properly ventilated. All the internal fittings to be arranged so as to encourage cleanliness and order.

The chief point on which it appears to us that insufficient stress has hitherto been laid in discussions of this subject, is the power of a large garden to meet the difficulty in the way of cottage building as a profitable speculation. The difference between agricultural rent and the rent which a cottager will give for a large plot of ground by his cottage will certainly help to repay the expenditure of the landowner.

The Homestead.—We do not propose to give plans or designs for farm buildings here. It must suffice to state the principles on which their arrangement ought to depend, and to describe in some detail the separate portions. The leading principles are the safety and well-being of the stock (both live and dead) requiring shelter; and the economy of labour. To this end yards for cattle should face the south, and sheds for implements should face the north. To this end also cart sheds should be near the stables, and hay and root and cake and chaff houses should be near the stables and cattle stalls and pig-sties. One of the farm products requiring shelter in farm premises is the manure made therein. The yards attached to cattle sheds should be small, or they should be entirely roofed over; so as to avoid the washing of the manure.

The common arrangement of a homestead is seen when from one line of buildings including straw house, dressing floor, granary, cake and meal house, and root

house, ranging east and west—with shedding abutting on the one side facing south for cattle, and perhaps a shed on the north side for carts and implements—there project shorter lines of buildings three or more in number (with open or covered yards between them), including stables, cowhouses, fatting stalls, pig-sties, with hospital, and accommodation of other kinds, as for poultry, slaughter-house, perhaps smith's and carpenter's shops, nag stable, &c. The stores of food and straw are thus arranged in a line along the ends of all these shorter ranges, and common to them all, and this enables the easy access of each to the necessary supply of food for live-stock; and the labour of attendance on all is thus reduced to a minimum.

The Buildings for stock commence with the stable.

The Stable.—The standard width of single buildings for horses or cattle is 20 feet, outside measure; the usual thickness of brick walls is 9 inches, excepting at the doorways, where they are increased to 13½ inch work; and a distance of 10 to 12 feet, piers of like dimensions are carried up to support the roof principals. This gives a clear inside width of 17 feet 9 inches at the narrowest part. Of this the space occupied by the manger and hay-rack, is 2 feet 6 inches; from the front of the manger to the outside of the heel post it is 9 feet; from outside of heel-post to gutter is 6 inches; and the gutter may be 1 foot 3 inches wide. This leaves a clear space of 4½ feet behind.

Next to boxes all horses do best in single stalls. For draught horses the width should not be less than 5 feet 6 inches; the stalls should have a very slight declivity from the sides to the centre, and also from the manger to the heel channel. The box system is too expensive for general

adoption, yet it is essential to have a certain number of boxes for the accommodation of breeding mares or sick animals. They should not be less than 9 feet square. The mangers are 2½ feet wide at the top, decreasing to 1 foot 6 inches at the bottom. Fireclay manger bricks may be used for the fronts. Manger bottoms and backs are then lined with 9-inch common brick quarries, set in cement. The best managers no longer regard hay racks as essential in a cart-horse stable; and the general adoption of machinery has, undoubtedly, rendered the use of chaffed and prepared food more economical, both as regards cost and efficiency. It is essential to have a constant water supply always available; but this can be provided at an open trough in the yard.

In some districts the practice still lingers of having a loft or tallet over the stable—a more unhealthy system can scarcely be conceived. The sticklers for it urge their claim principally on the plea of its value as a store-room. When subjected to the test of practical experience it proves a miserable failure, as either corn or hay soon becomes tainted and fusty when stored over a stable fully inhabited. The health, nay, even the very existence, of our domesticated animals, is dependent to a very large extent upon the purity of the air they breathe. The more artificial conditions under which they are placed render it essential that the natural requirements of the animal should be carefully studied and maintained; hence perfect ventilation, and a free circulation of air, are essential to the health of all animals.

The standings should be paved with materials of a durable character; these will vary with the locality. In some districts stone of a good quality may be obtained at a

cheap rate, whilst in others clinker bricks may be cheap and easily obtained. Granite sets are, undoubtedly, the most durable—their cost is the chief objection to their more extensive use. The space behind the horse, which is less subject to heavy wear, may be laid with asphalte. The Val de Travers asphalte is well known for its durability. Whatever the materials used for the surface covering, they should be placed on a layer of concrete composed of hydraulic lime and broken stone or gravel. The stable should be well lighted—the light should invariably issue from behind the horse. Stable doors should not be less than 4 feet wide in the clear; many prefer them in two horizontally divided halves, but this is not essential. In the Eastern counties horses are fed principally in open yards abutting on the stables, in which they only receive their corn in the manger, and may be tied up at night.

Cattle Stalls.—Opinions vary as to the best and most economical method of housing neat cattle; one gives the preference to covered yards, another to stalls, and a third to boxes. On considering the subject more closely in its various bearings on the health and comfort of the animals, we are led to the inference that the advocate of each is supported in his view by the results of his circumstances.

On large tillage farms, producing heavy crops of straw which must necessarily be converted into manure—where, in order to do this, a large number of young growing cattle are kept—undoubtedly covered yards are the best. The cattle have room for healthy exercise without being exposed to the elements. In the case of fattening animals, stalls, boxes, or the small yard (hammel) system of the Border counties is preferable. A most important feature of the

covered yard is its better conservancy of the manure. For dairy cows the double stall under good management is to be preferred. Though not so convenient or economical as regards labour, the single rowed cow-house is the more healthy. A building of equal width to that of the stable is necessary for the cowshed. No cowshed should be without a feeding passage in front. This should be 3 feet 6 inches wide; manger, 2 feet 6 inches; standing, 7 feet from manger front to lip of gutter; gutter, 15 inches wide and 3 inches deep. This leaves a clear passage of 4 feet 3 inches behind the cows, and gives, with ordinary length of roof, a cubic space of fully 600 feet to each animal, which is equal to the requirements of the Metropolitan Dairies Regulation Act. The best mangers are fire-clay troughs, specially manufactured, of a size exactly suited to the width of the stall. The stall divisions are of wood; oak posts are used for the back, 6 inches square in section, into which are housed grooved top and bottom rails, and these are filled in with 1 inch elm boards; the height may be from 3 feet 6 inches at the heel, to 4 feet 6 inches at the shoulder. A third post of equal dimensions is placed outside the manger, and the space is filled in to complete the division between each pair of stalls. Three lines of $1\frac{1}{2}$-inch gas-pipe pass through the further posts, in order to divide the manger from the feeding passage.

On extensive tillage farms, where large quantities of straw have to be converted into manure, and a large head of cattle must be kept, it is often found necessary to confine them in yards provided on one or more sides with open sheds. The sheds should be provided with a manger and furnished with bullock ties, in order that the animals may be tied up when artificial food is used. There should be

water troughs in every yard. This system is well adapted for the wintering of store cattle.

An abundance of light and exercise is essential to the healthy development of all young animals; hence the calf-pens should be warm and roomy, having access to a well-sheltered yard during the day. The building must be well ventilated; the floors should be formed of one of the various descriptions of concrete which are easily kept clean. All crevices which favour the accumulation of dung and urine are highly objectionable in a calf-house—for naturally decomposition takes place, and gases are evolved which are injurious to health. The pens should be made of sufficient size to accommodate from four to six animals. Each pen should be furnished with a small manger; iron is not only the best, it is also the cheapest material. For dividing the pens $\frac{3}{8}$ to $\frac{1}{2}$-inch iron pipe is sufficiently strong when supported either by wood or iron posts. The calf-pens should have doors facing the south, and be so arranged as to allow of being easily cleaned.

Piggeries.—Pigs are not generally considered very profitable stock, unless it be on large dairy farms where cheese or butter is made, and large quantities of whey or buttermilk have to be dealt with. Accommodation for one or two breeding sows, and a fattening pen, should however be provided. Where large numbers are kept, this can be done in one or other of the yards set apart for stock, choosing one with the deepest and most sheltered shedding for the purpose; and providing strong fixed troughs for their food. The usual custom of housing breeding and fattening of swine, however, is in long narrow sheds with separate compartments, each having a narrow entrance and an open

yard in front. The former is used as a sleeping, and the latter as a feeding place. We prefer that they should be entirely under cover. The ordinary 18-feet shedding admits of a very good arrangement, and one which can easily be converted to other purposes. In this case the front of the shed is formed of 10-feet brick arches filled up to the height of 4 feet. The bed and feeding places are separated by walls of the same height. The pigs are fed from the outside through swing-doors. We find this a more healthy and convenient arrangement than that of the old system. It is needless to add that piggeries should be constructed so as to avoid draughts, and should be well drained and kept clean.

Sheep-Yard.—On large breeding farms a sheep-yard is an essential building. A rough and ready erection is generally improvised to meet the requirements of the yeaning time, being generally demolished as soon as the temporary need has been supplied; but it is desirable to erect a more permanent structure, though still of an inexpensive character. The cheapest material for both roof and walls is galvanised iron. The yard must be proportioned to the size of the flock. It should be enclosed on three sides by a low shed 11 feet wide; the side facing the yard is supported on iron or wood piers, placed 9 feet apart. The best sheds have a passage 2 feet 6 inches wide, continuing the whole length of the building, in front of which is a low wooden manger 8 inches deep and 12 inches wide at top. One side is occupied by either portable or permanent lambing pens.

Waggon-Sheds are necessary buildings on every farm. They should not be less than 22 feet wide inside. The

waggon-shed proper has either elliptical brick arches, 10 feet wide in front, or 18-inch brick piers which support a bressummer. In other cases wooden or cast-iron pillars on stone plinths are used. The latter are liable to be broken by the negligence of a servant. At one end should be placed the blacksmith's forge and joiner's shop, and at the other separate bays for drill, reaper, and mower, forks, rakes, and other small tools: also a store for artificial manure. This too is the most suitable place for a granary overhead, which may extend the whole length of the building, except the part occupied by the smith's shop. It is entered by a stair placed at the end of the building. By means of an endless rope passing over a grooved wheel, or by a crane and winch arrangement, the full sacks are lifted from the floor or cart, and are landed in the granary. The grain is loaded into the cart in the same way; and this entirely dispenses with the old laborious system of carrying by men.

Barns, Dressing Floors, Food Houses.—Large barns are no longer a necessary part of the buildings of a farm; and the use of fixed barn machinery is now generally abandoned. Hence all that is now requisite is a dressing floor. Except under very favourable circumstances, it is found necessary, if a uniform sample is desired, to shoot the grain in a heap as the threshing proceeds, afterwards passing the bulk through a hand blower, from which it is sacked and weighed off for market.

With the altered systems of stock management, new requirements have to be met, the more urgent of which are suitable facilities for the preparation of artificial foods. Separate rooms are required for grist mill, chaff house, root house, and grains cistern. The chaff-cutter is best

placed in a loft over the chaff house; the root-pulper is likewise most conveniently placed in or close to the chaff house. All these machines are fixed and so arranged as to be driven from a single shaft, to which a portable engine can be readily attached. The chaff and mixing room should occupy a central position, with the root and mill rooms on either side. A small shed is necessary to house the portable engine. This shed should be so placed that the driving belt from the flywheel can communicate with a rigger on a main shaft, and thus supply the requisite power. On small occupations it will be found more economical to hire a threshing machine than to purchase it. It is a costly piece of machinery, which at most would only be used a few days in the year. Unless the water supply can be obtained by gravitation, the engine should be used to pump the water into a tank sufficiently elevated to command the whole of the buildings. The portable engine might be still further utilised during the busy period of spring or summer in working a small set of roundabout cultivating tackle.

Hay barns effect an immense saving, not only in the cost of thatch and labour, but also in avoiding the risk incurred by open ricks from the effects of sudden heavy rainfall during the progress of haymaking. These barns are usually 18 to 24 feet wide and 18 to 20 feet high to the springing of the roof. Iron or wooden piers are fixed in the ground, about 10 feet apart. A wall plate runs along the top, and thus tends to keep the piers in position. In order to increase the stability of the structure, short wing braces are sometimes added. Light principals of wood or iron are fixed 10 feet apart, the roof is covered either with $\frac{3}{4}$-inch boards or corrugated galvanised sheets, the latter for preference. With fair usage they will last for many years.

Some provision should be made on every farm for the housing of poultry. The floor is best made of plaster or asphalte, or such other material as can be readily cleaned, and free from all crevices likely to form a harbour for insects. The building should be well lighted and ventilated, and fitted with nests and roosting perches. Separate places are required for turkeys, geese, and ducks; these should open to the outside and not into the yard.

Grain pits.—In the dairy districts a tank for the storage of brewers' grains is an essential of every homestead. A great economy is effected in purchasing grains during the summer months, when the demand is inactive, and hence the prices are moderate. The grains cistern is made 4 to 6 feet wide and long, and from 4 to 6 feet below the level of the surrounding ground; it is essential that it be watertight; hence it is either built in cement or hydraulic mortar. This erection must be close to the mixing room in order to save the labour of removal from a distance. The grains are trodden in and may be covered on the top with a layer of well-tempered clay to exclude the air, and thus we have a silo which has been in general use amongst the dairy farmers of Derbyshire for probably a century.

Silos must be mentioned here, although they are at present only an exceptional part of farm equipment, and still of uncertain policy. They may be either 10 or 12 feet cubic tanks as it were, dug into the solid clay subsoil, walled with concrete and provided with a heavy covering, as of boxes filled with stones, to give the requisite pressure for the exclusion of air from their contents. In these may be stored various green and even succulent forms of vegetable growth with no other preparation than what may be

necessary (as by chaff-cutting) to ensure close packing. And, remaining under pressure here during the autumn months or even longer, the contents of these silos (green rye, clover, grasses, &c.) become available for cattle food in a palatable and nutritive form, long after they have been thus packed away. Or such silos may be provided above ground, as Mr. H. Woods of Merton, Norfolk, has pointed out. Old barns and other disused out-buildings may be turned to account in this way—the existing walls with added transverse mason-work being all that is necessary to form the air-tight pit which when supplemented with heavy pressure at top is all that is required.

Further Details.—The inside details of farm buildings are of considerable importance. Formerly, we constructed all mangers of blue bricks, specially made for the purpose; these, though of great durability, were costly. We have now discovered a much cheaper and an equally suitable substitute in the shape of fire-clay troughs 6 feet 6 inches long, of sufficient width and depth. Two lengths suffice for a double standing, the ends butting together form a central division, thereby insuring each animal its own share of the food. Where stone is plentiful and cheap, no more suitable material can be used as a heel-stone. Bricks on edge, either blue or common, suit the purpose, though much less durable than good stone. The space from the wall to the face of the gripstone with gutter, should drop 4 inches. This is much safer than where a deep narrow grip is formed. Brick-paving, owing to its slippery nature, is objectionable; and unless laid on a bed of concrete, and set in cement, it forms a lodgment for urine and other objectionable matters, which in time set up chemical action; and the evolution of gases

is injurious to the health of animals. For the beds we find well-made concrete consisting of gravel and hydraulic lime when skilfully laid cheap, durable, and efficient. As stated elsewhere, we strictly prohibit all underground drains. Where a sufficient supply of water can be obtained the cow-houses should be flushed out daily.

There exists some difference of opinion amongst practical men as to the arrangement of the stable. On some farms the work-horses are housed in an open shed without any stalls, whilst in others each horse is divided from his neighbour by a wooden division: this is generally to be preferred as insuring greater comfort and less danger of accidents. We prefer brick to wooden or iron mangers in the stable, similar to those already described for cattle. The old-fashioned system of high racks is discontinued in modern erections: racks, if used at all, are on the same level with the manger, and slotted in front. Work-horses are now generally fed on prepared food, hence the need of a rack is obviated. The standings should be pitched with durable materials, in order to withstand the constant and heavy wear and tear. Whatever material is used for pitching, the interstices should be flushed up with grout composed of hydraulic mortar, in order to prevent the collection of urine. Perfect ventilation, plenty of light, and immunity from draught are necessary. A separate place should be kept for the harness. Evaporation from wet leather vitiates the atmosphere, and is injurious to health. Lofts over stables or cattle sheds can only be tolerated in large towns, where land is expensive; and, in this case, we should recommend that when possible the animals should be lodged in the upper story, and the ground floor used for storage! A loft over live animals not only

injures their health, but deteriorates the value of hay or corn stored above.

An enclosed and covered manure pit is desirable near a farmyard; and a liquid manure tank may be placed at one end of it, into which the entire drainage should be conducted. By this means, the manure is protected from washing by rain and from the wasting effects of exposure to the atmosphere. Although large barns are no longer a necessity, yet on the majority of farms in the Midlands, they are the most substantial building on the farm. They might be easily converted to a better use. One or both bays might be readily converted into a food-preparing room. A storage loft may be placed over the bay; on this the chaff-cutter can be fixed, and the ground floor will be useful for a mixing place.

Materials.—The changes which have taken place within the last decade, as well as others obviously looming in the distance, induce prudent men to pause before embarking in large expenditure on buildings which in a few years may not be required; hence the more intelligent are turning their attention to less costly, yet at the same time less durable erections.

In many cases wood or concrete is taking the place of brick walls. We have given both a fair trial, being well provided with manufacturing plant and machinery. And we have not succeeded in reducing the cost of building by the substitution of other material for bricks.

We have however succeeded in erecting serviceable buildings of a temporary character, that is, with a probable life of 20 or 25 years. The walls are constructed of old railway sleepers set on end, with a wall plate on the top of 6 inches

by 3 inches; and on this is placed a light wooden roof covered either with galvanised iron, or with the specially prepared paper, manufactured by the Willesden Company, This makes a cheap covering, perfectly impervious to wet. which will last some years. For the covering of farm buildings of a more substantial and permanent character, the blue Staffordshire tiles are good. Though heavier, and hence requiring timbers of greater scantling, they are much easier replaced when broken. In an ordinary building 20 feet wide, outside measure, to be covered with Staffordshire tiles, we use timber of the following sizes: wall plates 4½ inches by 3 inches; principals 7 inches by 2½ inches; tie beam 9 inches by 3. A ¾-inch iron tie rod, attached to a strap passing round the tie beam and secured by a nut and screw, passes through a curved iron plate, which embraces the backs of the principals at the top. There is a single purline on each side 5½ inches by 3 inches; the rafters are 3 inches by 2 inches, and 16 inches apart from centre to centre; the ridge-piece is 6 inches by 1½; and the tiling laths 1 by ⅝ inch. When finished the ridge is capped with blue Staffordshire tiles, some of which are cast with a boss on each side, and this forms an efficient and ornamental ventilator. In the case of galvanised iron or slate we entirely dispense with rafters; the principals are constructed of the usual dimensions; two purlines instead of one are placed on each side of the roof, which is covered with ¾-inch "matchboard" laid vertically from wall plate to ridge, and to this the iron or slates are nailed. This makes a most substantial roof at a considerable saving in cost.

Some proprietors make a point of using larch and other timber grown on the estate, in the construction of roofs

and doors of buildings. This is mistaken economy, entailing endless disappointment and grievous loss: the labour of converting the timber is costly, and the work unsatisfactory. Where the timber was used in a green state we have been obliged to strip and re-roof buildings within 15 years of their erection. We prefer white Baltic timber for roof, purchased in planks, deals, and battens. A plank is 11 inches, a deal 9 inches, and a batten 2 inches wide, the general thickness being $2\frac{1}{2}$ inches to 3 inches. With a little forethought as to the purposes for which they are required they can be converted with the least possible waste. For doors and windows we prefer red deal. We generally use either English oak or pitch pine for window cills. The latter, though difficult to work, is cheaper than oak and equally applicable to the purpose. In some cases dressed stone window heads and cills are used: they increase the cost without adding much to the practical utility of the building. Blue bricks may be used for cills, for window and door heads; and for them we prefer elliptical brick arches with a rise of one inch to the foot.

Except on large estates where a regular staff of mechanics are employed with the assistance of improved machinery, it is cheaper to purchase ready-made joinery; particularly where the proprietor lets the brickwork and joinery separately. The ironwork to doors should be of a substantial character; the bands and hooks should be of wrought iron, the former secured to the door ledge by a screw pin passing through the whole thickness of the wood and secured by a nut on the inside.

General Conclusions.—In the erection of farm buildings, utility and economy are the chief points to consider.

There can be no real economy where inferior materials or workmanship are tolerated. On all large properties bricks should be made on the estate; and where the work is of sufficient magnitude to warrant the outlay, the various kinds of woodworking and other machinery may be properly used with a staff of mechanics under good supervision. Most of the work can even then be done at piece prices; and the labour on roofs, and other details of new work, can readily be let at per foot or yard; whilst on small estates the joinery can all be purchased ready made. We do all our new brickwork, paving, slating, tiling, plastering, &c., at per yard; the landlord finding the materials and building plant.

The value of labour and materials and the measuring of artificers' work might be more closely studied than they are by men in the land agency profession. On some estates the buildings are let by contract; and in this case the professional architect is generally called in, or a clerk of works employed. Agricultural architecture and engineering clearly belong to the higher branches of the land agent's profession. The time and study required even to arrive at mediocrity should not deter young men from endeavouring to gain a practical knowledge of them.

To those intrusted with the designing and erection of farm buildings, a perfect knowledge of the practical wants of the farm and a complete mastery of detail are of prime importance. Important hints and suggestions may sometimes be received, for the tenantry should be carefully considered; but, in effecting improvements of a permanent and costly character, the probable capabilities of the land should be studied rather than the whims and fancies of one who may throw the farm up the next year and be suc-

ceeded by another whose views are diametrically opposite. It is seldom that the farm architect has the opportunity of erecting a completely new homestead—his efforts are more generally directed to alterations and additions to existing buildings. Here a grasp of practical detail is invaluable; old buildings have to be repaired, re-roofed, and rearranged, and additions made when required. And let us repeat it: —whether in the erection of new, or in the rearrangement of old buildings, one of the chief points to be considered is the economy of labour. From this cause alone the cost of attending the stock may vary 50 per cent. Those parts of a homestead connected in use should be connected in position, so as to diminish the labour of carrying food and litter, and of removing manure; so as indeed to diminish the labour of attendance on stock. The root and chaff barn and the straw barns must be near the cattle stalls and stables. And, though of less importance, the stables must be near the implement shed and waggon-house.

The health of the animals is of the greatest importance; well ventilated buildings, which insure a circulation of pure air without being subject to oppressive currents, are conducive to health. All open sheds should have a southern aspect. Covered drains should on no pretence be tolerated inside well-constructed farm buildings; they are constantly liable to obstructions from whence arise odours of the most offensive and pestilential character. Surface channels are readily cleansed; any collection of superfluous matter meets the eye and is at once removed. All the buildings should be well lighted and ventilated; the light should invariably be admitted from behind instead of at the head of the stock. The ingress of atmospheric air should be on the floor line.

Sufficient openings at the ridge must be provided as a means of egress and to insure a perfect and continuous circulation. This may be done by simply letting every alternate ridge-tile rest on the edges of the neighbouring tiles which are arranged on the ridge-piece. The inside of all buildings for the use of live stock should be lime-washed at least once a year. It is false economy to allow doors and windows to remain long without repainting; two coats in plain colours every three years will keep them in good condition. Formerly farm homesteads were seldom furnished with eaves spouting; this entailed an outlay considered quite unnecessary. Practical experience has long convinced us of its utility. Where there are no spouts the eaves drip, and soak into the walls, causing them to be invariably damp inside. The bricks being constantly saturated with water, a severe frost setting in shatters them into fragments.

The chief points to consider in the erection of farm homesteads are efficiency and economy. Both are frequently sacrificed to whim. As a case in point, we were consulted a short time ago as to the sale of a small and very compact estate of good grass land, which had for many years been occupied by the late owner, who a few years before his death was induced to erect what was called a model homestead. The property was put up to auction, and, after several abortive attempts, was eventually sold for less than the cost of the buildings. Landlords would best study their interests by having buildings erected under the inspection of a competent man, as is the case where the money for the purpose is borrowed from Land Improvement Companies, and spent under the supervision of the Land Commissioners.

CHAPTER VIII.

THE LANDLORD'S CAPITAL.

Dairy Farms—Mixed Farms—Grazing Farms—Upland Farms—Tenant Right Legislation—Lands Improvement Acts—Borrowed Capital—Settled Lands Act.

THE Landlord's capital includes, not only the bare *corpus* of the estate, but all of it, beyond the mere "inherent capabilities" of the land, which has not been contributed by the tenant. It includes the fences, roads, buildings, drainage, which have been referred to in the preceding chapters; and which together have made the land suitable for the application of the capital and skill of the farmer to the work of cultivation. The sum, per acre, to which these several items amount, varies exceedingly with the purposes to which the land is devoted. On rich grazing ground few buildings and few roads, good fences, drinking ponds, and occasional drainage may be required, along with the farm-house and a cottage or two. Grass lands devoted to dairy purposes require larger accommodation for cattle and for the dairy itself—buildings, yards, water supply, &c.—together with houses for the tenant and his labourers. In the case of arable cultivation, again, you require ample buildings for the care of live-stock, implements, and produce; and many cottages in addition to the farm-house. There are also fences, roads, and often much drainage needed.

In Mr. Squarey's report on "Farm Capital" to the Royal Agricultural Society of England, a dairy farm of 200 acres at 50*s*. per acre, worth, therefore, £15,000, is stated to have £2,250 spent on buildings, water supply, and dairy accommodation—£1,000 on drainage and £500 on roads. This is £4,030 in all, out of the £15,000 for the land as equipped. The tenant's capital is put at £2,400, and the three items—bare land, equipment, and tenant's capital—stand at 63, 23.2, and 13.8 per cent., respectively, of the whole value of the farm as it is being worked.

In like manner, on a mixed farm of 500 acres at 30*s*. an acre (apparently not requiring drainage), the land in its natural condition, is considered to be worth £17,500—the equipment £5,000, and the tenant's capital, £6,000—or 61.4, 17.5, and 21.1 per cent. respectively.

On a grazing farm of 300 acres at 63*s*. per acre, also not needing drainage, the value of the land is £28,350; sheds, yards, water supply, &c., £2,600; and tenant's capital £4,500;—or 78.38, 7.9, and 13.71 per cent. respectively of the total capital employed on the farm, as it is being worked.

It is with the landlord's equipment only that this chapter is concerned. This will often amount to £3 per acre over the whole land (supposing half of it needs to be drained) for drainage alone, at least £1 per acre for fences, sometimes nearly £2 an acre for roads, £3 to £5 an acre for farm house and cottages, and more than this for farm buildings, water supply, &c. And it may vary in the total from a sum perhaps one-half the capital of the tenant in the cases of the richest grazing grounds and wide upland estates, to quite twice the amount of the

tenant's capital in ordinary arable and dairy farms which are well equipped.

The amount of the necessary landlord's capital thus varies exceedingly with the circumstances of the estate. And where the equipment is deficient, there is a demand upon the purse of the owner for the due provision of what is necessary under the several enumerated heads before an intending tenant can offer a fair rent for the use of the land. Of course it is within the option of the tenant, if he can make a fitting bargain on such terms, to provide any of the necessary equipment of the estate himself at his own expense; accepting a lease of the land for a sufficient term of years at a rent low enough to recoup him. But this is really intruding into the province of the landowner, and he then virtually becomes accordingly part-owner as well as occupier of the land during the term of his tenancy. The security of his capital applied in this way is assured by the bargain which he has made; and it is especially necessary in such a case that he should take care of himself when the terms of this bargain are arranged. The necessity of this security in the interest of the country generally—the prosperity of which is largely affected by the success of its agriculture—has led of late years to legislation for the provision of security for that part also of the capital of the tenant, which is applied strictly to the work of cultivation. And any improvement of the estate—due to the energetic conduct of his business—which can be claimed as really his work, is now repaid to an out-going tenant; who is thus encouraged to the vigorous prosecution of his business to the very end of his occupation.

In the case of the landowner, too, the difference be-

tween listlessness on one side, and enterprise on the other, is seen so obviously in the condition of his estate that it is the interest of the country generally that the application of the landowner's capital to the land should also be in every way encouraged. The landowner in this country is to very large extent a mere tenant for life, and his insecurity is of the very same kind as that of a tenant at will. The successor named, in any such case, in a deed of settlement may be his own son, but the interests of the others of his family having to be considered, he has often been induced to treat the estate with niggard economy in order to accumulate for them. In order that he too may be encouraged to the enterprising discharge of his duty (to the estate and country) as an occupant of the land, his outlays are to a certain extent also made sure to him. He is not indeed allowed, after any settlement of the land, to charge upon the incoming tenant, his successor, the whole improvement—apart from the inherent capabilities of the land, or the increased market value—which he has effected, but he is allowed to charge his estate for a term of years with the cost of his improvements,—raising money for the purpose by means of an annuity to the lender for the term of years agreed upon. In this way the tenant for life is enabled to discharge his duty to the property without neglecting the interests of his family. The charge does not come directly out of his pocket, but is defrayed year by year for a term of years whether he should survive or not, by a charge upon the land.

It is plain, however, that the interests of his successor also need to be protected. And the Lands Improvement Acts of recent years, which have introduced this

really beneficent method of removing the disability of the tenant for life, very properly require the whole transaction to be carried out under the direction of a Government Department. There are several companies having private Acts, in addition to the general Land Improvement Acts, through which money can be obtained for estate improvement—as for the provision of buildings, roads, fences, embankments, drainage, even shelter (by plantations), &c., who provide money at various terms according to the state of the money-market—generally at the price of an annual rent-charge for 25 years of £6 10*s.* to £6 15*s.* per cent. of the amount lent. But in all these cases, any proposal from an owner, when once accepted, comes before the Land Commissioners of England,* who examine the plans, and by their inspectors investigate the circumstances. And if the proposal appears to them to be in the permanent agricultural interest of the property, they allow the rent-charge after the due completion of the works has (again by the inspectors) been certified. A list of the Land Acts and of these Land Companies, through any of which the necessary Landlord Capital can be obtained, is given in the Appendix. They are all, except the Land Drainage Act and the Limited Owners Residence Act, for general works of agricultural improvement. And any of the five companies named have ample powers for all the purposes which the owner of any estate requiring re-equipment or permanent improvement can desire to have served.

The following list of such purposes is taken from the published prospectuses of the various Lands Improvement Companies, and is generally true of all the companies

* 3, St. James's Square, London, S.W.

named in the Appendix, from any one of whom full particulars of the mode of procedure are obtainable at the addresses given.

Drainage of land, and improvement of watercourses. —Irrigation and warping. — Embanking from tidal waters, lakes, rivers, or streams.—Inclosing (including chalking). — Reclamation. — Making permanent farm roads and permanent tramways and railways for agricultural purposes.—Clearing.—Erection of farm houses, labourers' cottages, and other buildings required for agricultural purposes, and the improvement of and permanent additions to farm houses, labourers' cottages and other buildings for agricultural purposes.—Planting for shelter, or for any beneficial purpose which will increase the permanent value of land.—Construction of engine houses, waterwheels, saw and other mills, kilns, shafts, wells, tanks, reservoirs, conduits, bridges, wells and sluices, which will increase the value of land for agricultural purposes.—Construction or improvement of jetties or landing places for the transport of cattle, sheep, and other agricultural stock and produce, and of lime, manure, and other articles and things for agricultural purposes, such works adding sufficiently to the permanent value of the adjoining lands.—Construction of reservoirs for the supply of water.

In all these cases the only condition required is that the proposed improvement shall increase the agricultural value of the estate by an amount in excess of the amount of the annual charge which the cost of it will create.

The latest legislation * does indeed enable a tenant for

* Settled Land Act, 1882 (45 & 46 Vict. c. 38).

life to sell portions of a settled estate for the due equipment of the remainder, and for all those purposes for which the previous Lands Improvement Acts were passed—but it is not likely that this power will be largely used so long as money can be raised with perfect safety to the integrity of the property in any other way.

APPENDIX.

We have given here memoranda, of service to the reader, from which he will refer to the several chapters and page enumerated.

A. Agricultural Implements (Chap. I. pp. 3–30).—The following price list is taken from recent catalogues :—

Ditching machine (Storr's), £500.
— — (Fowler & Co.), £110.
Draining plough (Eddington & Co.), £30 to £60.
— (mole) (Fowler), £27 10*s*.
— machine (Abbott), £390.
— tools, set of (Spear & Co.), 18*s*.
Drain pipe machine (Barford & Perkins), £16 16*s*.
— — (Whitehead & Co.), £65.
— — (Page & Co.), £55 to £111.
— — for hand power, £18.
Pugmill (Whitehead & Co.), £13.
Drainage fittings (Denton), £3 10*s*.
Gripping plough for wet grass land, (Howard), £4 to £7.
Draining levels, from £1 to £6 6*s*.
Root and stone extractor, £10.

Ploughs, single furrow, from £2 10*s*. to £6 10*s*.
— double furrow (Murray), from £6 10*s*. to £13.
Ploughs, three furrows (Howard), from £6 10*s*. to £12 15*s*.
— four furrows, light (Howard), £6 17*s*. 6*d*.
— subsoil from £4 to £6.
— Ridging (Cooke) from £3 to £8 10*s*.
— Gang (Howard), £14 5*s*.
— — (Cooke), £13.
— Turnwrest (Howard), £2 5*s*.
— (Murray), to £10.
Whippletrees, from 12*s*. to £2.
Harrows, from £3 to £5.
— Chain, from £2 10*s*. to £7.
Cultivators, &c., (Clay), from £7.
— (Coleman), from £5 10*s*.
Horse hoes for turnips, £2 to £3.
— — (two to twelve rows), from £3 to £18.
Hand picks, mattocks, and grubbers, from 2*s*. 6*d*. to 6*s*. 6*d*.
Cast steel hoes, from 10*d*. to 1*s*. 6*d*.
Rollers, from £1 10*s*. to £24.
Clodcrushers (Crosskill), £19 10*s*.
— (Cambridge), 20 to 30 rings, £7 to £12.

Steam Cultivation.

(*Fowler & Co.*)

5 furrow balance plough, £113.
3 furrow (Cuban), plough, £122.
2 furrow subsoiler, £110.
2-tine balance grubber, £70.
3-tine " " £85.
Turning cultivators, from £60 to £102.
Harrows, from £75.
Anchors, from £50.
Ploughing engines, 10 h. p. compound single-drum, £752 2*s.* 6*d.*
— — 10 h. p. double drum. £753.
— — 16. h. p. compound single drum, £932 5*s.*
2 wheeled water cart, £25.
6 ton waggon, £70 ; with springs and brake £13, entire £83.
Sleeping van, 6 men, £85.

(*J. F. Howard & Co.*)

4 furrow balance plough, £75.
Steam cultivator, £80.
Anchor, self-moving, £50.
Sleeping van, £100.
Water cart with pump, £25.
Steam harrows, from £20 to £27.
Farmer's engine, 2 drums, £600.
A single engine "set," £950.
A double engine "set," £1730.
Darby's steam digger, £1000.

(*Barford & Perkins.*)

4 furrow balance plough, £75.
7-tine cultivator, £25.
Windlass, £80.
Anchor, £50.
Drag harrow, £55.
Chain and notched pulley, for connecting windlass and portable engine, £21 10*s.*
Double drum ploughing traction engine, £550.
Set of steam ploughing tackle, *i.e.*, windlass, 1,600 yards steel wire rope, cultivator, 2 self-moving anchors, claw-anchors, and snatch blocks, £350.

Fiskin's light rope system, from £200 to £400.
Portable engine, £200.
Rope porters, from £1 to £3.
Snatch blocks, £2 10*s.* to £5.

Continuous iron fencing, 2*s.* to 3*s.* per yard.
Iron hurdles (sheep and cattle), 2*s.* 6*d.* to 5*s.* per yard.
Standards for wire fencing, 5*s.* 8*d.* per doz.
Oak field gates and posts (Braggins), £3 7*s.* 6*d.*

Corn and seed drills (Smyth), from £23 to £30.
Press irons, fore steerage, £6 extra.
10-row, general (Coultas), £46.
Chain drills (Denning), £29 10*s.*
Anglo-American force-feed drill (Coultas), £26 5*s.*
Broad cast corn and seed sower (Reid), from £12 10*s.*
— manure distributor, from £19 to £30.
— chain delivery £30.
2-row turnip drill on the ridge, from £6 15*s.* to £7 7*s.*

1-row turnip drill on ridge, £2 10*s.*
6-row turnip manure drill on the flat, £32 10*s.*
Barrow broadcast seed sower, £4.
Hand drill for "patching" purposes (Boby), 10*s.* 6*d.*
Liquid manure and seed drills, from £25.
— — (Reeves), to £53.
Corn sowers for attaching to plough, £1 10*s.*
Bone mills, from £16 16*s.*; ½ to ¼ in. £225; ½ in. to Dust £325.

1-row potato planter (Murray), £12 12*s.*
2-rows ditto ditto £17 14*s.*
3-rows ditto ditto £23 10*s.*
Potato digger (Penny & Co.), £16.
— grader or separator (Penny & Co.), £8 10*s.*
— root washers, from £1 to £6 10*s.*
Turnip topping and tailing machines, from £4 10*s.*
— — (Hunter), £9.
— thinner (Hunter), £12.
Mowing Machine, £17 to £20.
Mower and reaper combined, £25.
Self delivery raker, from £27.
Sheaf binding reapers, from £60.
Haymakers, from £10 to £17.
Horse-rakes, from £9 to £10.
— — Anglo-American, £8.
— — American, £2.
Hand-drag rakes, from 10*s.* to 16*s.*
Corn and hay rakes, per doz., from 15*s.* to 19*s.*
Hay-forks, from 2*s.* to 2*s.* 6*d.* each.
Horse pitchfork, £2 12*s.*
Hay and corn stacking or elevating machine, from £34 to £40.
Pony gear for driving do., £7 10*s.*
Hay press (Pilter's), £120.
Straw and hay compressing machine (Ladd), £230.
Harvest Saver (Gibb's), from £200 to £400.
Exhaust fans for stacking, from £5 10*s.* to £12.
Stack borers, £3 3*s.*

Thrashing machine, from £130 to £140.
Chaff-cutting, riddling, and bagging machine (Clayton and Shuttleworth's), from £48 to £52.
Chaff-engine (Maynard), £53
Straw yealming machine, £22
Straw elevator, £45.
Clover seed drawer, £56.
Corn screens, from £4 10*s.* to £30.
Winnowing machine, £5 17*s.* 6*d.* to £11 12*s.* 6*d.*
Grain separator (Walworth), £28 to £52.
Sack-lifting barrow, £2 10*s.*
Sack-lifter and weighing machine, £6 6*s.*
Common sack-barrow, from 20*s.*
4-bushel grain sacks, 1*s.* 6*d.* to 2*s.*
Iron rick-stand, £3 16*s.* 6*d.*
Hay barn, 20 ft. × 25 ft. × 20 ft. £36 10*s.*

Chaff-cutters for hand power, from £1 17*s.* 6*d.* to £8.
Chaff-cutters, power machine, from £10 to £32.
Corn grinding and kibbling mills, from £4 15*s.* to £28.
Corn and linseed crushing mills, from £2 2*s.* to £8 15*s.*

Oil cake mills, from £3 to £7.
Turnip cutters (Gardner's), from £5.
Turnip-pulpers, from £3 10*s.* to £7.
Cooking apparatus, from £23 10*s.*
Gorse mill (Mackenzie), £15 15*s.*

Hop-cultivator or nidget, from £4 10*s.* to £6.
Hop-syringing engine, from £9 to £30.
Hop-sulphuring machine, from £12.
Hop-presser, from £13 to £27 10*s.*
Hop, grain, and malt drying machine (Gibbs), 18 ft. × 4 ft., £90.
Coley's vinery system of poling, per acre, £52 3*s.* 4*d.*
— old system, per acre, £41 6*s.*
Yearly expense of the former, 15*s.*
— — of the latter, £4.
Capell fan, for rick drying, ventilation, &c., to extract 2,800 feet per minute, £8 10*s.*; 9,000 feet, £24.

De Laval cream separator . . £32
— intermediate motion 5

£37

Steam cheese-maker (Wilkin & Sons), £28
Barrel churns, for 6 lbs. of butter, £2 5*s.*
— (Hathaway), 12 lbs., £6 15*s.*
End-over-end churns, 6 lbs. butter, £2 15*s.* (Waide), 85 lbs., £7 10*s.*
Oscillating swing churn, £2 17*s.* 6*d.*
Oscillating patent crank swing Churn, from £2 10*s.*
Steward's patent churn, (Hathaway), £2 10*s.* to £4 10*s.*
— Atmospheric churns, from 12*s.* to £2 5*s.*
Milk coolers (Lawrence), £4 to £24.
Cooley creamers, from £5 15*s.*
Swartz system, 75 gallons, £9 5*s.*
Milk strainers, from 4*s.*
Cheshire milking-pail, 4*s.* 9d. each.
Block-tin setting-pans, 2*s.* 9d.
Earthenware pans, from 1*s.*
Taylor's rotating stand, for 30 pans, £6 6*s.*
Bradford's setting stand, £3 3*s.*
— — hardwood, £4 4*s.*
Cream jars, from 6d. to 1*s.* 3d.
Milk-weighing machines, from £12 12*s.* to £26 5*s.*
Yokes, from 7*s.* 6*d.* to 12*s.* 6*d.*
Butter workers, circular motion, 1 to 10 lbs., from £3.
— — (Llewellin), 20 lbs., £7 10*s.*
— — Barford's "Albany," from £1 10*s.*
— — Reciprocating motion, to £5.

Cheesemaking apparatus, Cluett's, £18 3*s.*
Curd mills, from £2 to £3.
Cheese vats, from 1*s.* 6*d.* to 3*s.* 6d.
Cheese presses, from £2 to £7.
1 horse cart, £12 to £17.
— fitted with patent tipping apparatus, £19.
Harvest cart (Crosskill), ditto, £17 10*s.*
2-horse ditto ditto, £19 10*s.*
Market cart on springs, £19 10*s.*
Dog cart 2-wheel, from £25.

Dairy cart on springs with crank axle, £21 10*s.*
Farm waggons, from £30 to £40.
Market waggon, £28 10*s.*
Patent tipping waggon, £40 to £50.
4-wheel cattle van, £50.
Cattle conveyance, spring cart, £31.
— — with cover, £38 10*s.*
Water carts (60 gal.), £9.
— — (150 gal.), £22 7*s.*
Tumbler or sanitary cart, 200 gals., £38 10*s.*

St. Pancras patent fittings for loose box, from £20.
— — for stall, from £9.
Manger for loose box, from £3 15*s.*
Manger for stall, from £4 12*s.* 6*d.*
Wrought-iron surface gutters, per foot, 2*s.* 6*d.*
— — covered, 2*s.* 9*d.*
Syphon drain-pot, £1.

Improved cow-house iron fittings, from £3 per cow.
Willacey's cattle-feeder, £25.
Double cow-house manger, per yard, £2 10*s.*
Tramways, per yard, 10*s.*
Turntable, £3
Bellamy's drinking troughs, galvanised, 75 gallons, £2 5*s.*
— — 120 gallons, £5 7*s.* 6*d.*

Shepherd's hut, on wheels, £22.
Sheep-rack and trough combined, (J. Edwards & Co.) from £2 12*s.* 6*d.* to £5 10*s.*
Sheep netting, tarred hemp, in 50-yard lengths, £1 5*s.*
Sheep hovels and lamb shelter of Willesden paper, 54 inches wide, 2*s.* 3*d.* per yard.
Agricultural shelter of Willesden paper, 15 feet by 12 feet, £2 10*s.*
Bigg's sheep-dipping apparatus, from £4 15*s.*
— — Portable, £16.
Tomlinson and Hayward, hand-dipping apparatus, £5.

Incubators (Christy & Co.), from £1 10*s.* to £12 12*s.*
Fattening coops, from £1 to £10.
Drinking fountains, from 2*s.* 6*d.* to 8*s.* 6*d.*
Feeding troughs, from 2*s.* 3*d.*

Hart & Co., Cart-weighing machine, 3 tons, £42 10*s.*
— — Cart and cattle, £51.
— — Cattle only, £33 10*s.*
— — Calves, sheep and pigs, £14 15*s.*
— — Sacks of corn, 3¼ cwt., £7 15*s.*
— — 4¼ cwt., £8.
— — 6¼ cwt., £10.
— — 10¼ cwt., £12 5*s.*
— — 25 cwt., £20 10*s.*

Portable steam engine, 2½ h-p. (Brown & May), £110.
— 6 h-p., £180
— 16 h-p., £375.
Compound portable, 12 h-p., £365.
Compound semi-portable, 12 h-p., £383.
— — 20 h-p., £535.
Traction, 8 h-p., £400.
— 8 h-p., with springs (Maclaren & Co.), from £450.

Traction, 8 h-p. (Fowler), £575.
— 6 h-p. (Foden), £400.
Horizontal, 8 h-p., £70 to £80.
Compound Horizontal, 6 h-p. (Shanks & Son), £55.
— — 16 h-p., £190.
Vertical, 1½ h-p. (Hindley), £47.
— 2 h-p., £55, ,,
— 4 h-p., £94, ,,
Vertical compound, 4 h-p. (Shanks & Son), £80.
— — 6 h-p., £120.
— — 8 h-p., £150.
Multitubular vertical, 8 h-p. (Cochran's), £140.

1-horse pony gear, £7.
2-horse gear, £11 15*s.*
Intermediate motion, £3.
4-horse gear with intermediate motion, £36.

Gas engine "Otto" ½ h-p. £60.
— — 12 h-p. £330.
Turbine water-wheel 22 h-p. on 20 ft. fall, £60.
Vortex turbine 20 h-p. water-wheel on 40 ft. fall, £90.
Drainage Turbine (Holmes), £100.
Centrifugal pumps, £15 to £40.
Chain pumps, from £3 15*s.* to £36.
Hydraulic ram, from £4 to £13.
Deep well pumps, from £7.
Cottage pumps, from 18*s.* to 20*s.*
Irrigation pumps (Warner), £80.
Steam pumps, from £46.

Cider mill (steam power), £18.
— — with horse gear combined, £35.
— press-double (Humphries), £36.
Broomer cider press (Ladd & Co.), from £75 to £135.

Stone breaker (Hall), from £65.
10 ton steam road roller, £400.
Priestman's dredger, from £295.
Road scraper, from £3 to £4.
Portable railway (Fowler), 3*s.* 6*d.* per yard.

B. Farm Equipment (CHAP. II., pp. 31–60).—We give here the report of Mr. Wm. Morton, of Lambieletham, St. Andrews—No. 5 in our table at p. 49—as stating his expenses for the year 1883.—At this time, when our agricultural year ends, I am able to ascertain the total expenses for the year on this farm, where a very considerable acreage of green crop is grown. The 610 acres is divided into two farms, which adjoin one another. One we will call the home farm, and the other the off farm. They are worked separately; though during seed time and harvest all the force is concentrated when occasion requires. This year we have had ten men, five on each farm; an extra pair of horses has been kept on the off farm, as we were rather behind last year owing to the late season. The grieve (steward or foreman), who is also cattle-man, worked the

extra pair, and an old man was employed to attend to the cattle. This has not entailed any extra outlay for wages. The wages of the men run from £20 to £28, and the average is £25 to this fall; the added wages "in kind," amounting to £20, bring up the wage in all to £45 per annum. The perquisites are—meal, 70 lb. per month, valued at £6 5*s.*; milk, half gal. per day at 10*d.* per gal., £7 12; potatoes planted, £2; house, £3; coals driven, £1. The wages of the ten hired men at £45, amount to £450; and the amount paid to women and two "orra" men, with extra help, has been £212 16*s* 8½*d.*, or a total of £662 16*s.* 8½*d.* The cost of manual labour on the 610 acres is thus £662 16*s.* 8½*d.*, or £1 1*s.* 8½*d.* per acre. You will now want to know how many acres of green crop, corn, and pasture, are worked at this rate of £1 1*s.* 8*d.* per acre. On the home farm we had 36 acres wheat, 32 acres barley, 54 acres oats, 3 tares, 27½ acres potatoes, 44½ acres turnips (72 acres green crop), 25 acres hay, 91 pasture (12 acres of which, seeds, should have been hay). On the off farm there were 30½ acres wheat, 32½ acres barley, 40 acres oats, 13½ acres potatoes, 39 acres turnips, 7 acres bare fallow, 4 acres tares, 32½ acres hay, 35 acres pasture in rotation, 62½ acres permanent pasture; 124 acres out of the 610 are in green crop. On the two farms eight pairs of horses have been kept but, besides doing all the work on the farms, over 300 tons of dung have been driven. About 100 cattle are kept during winter; over 200 cross-bred lambs are fed on turnips, and 70 breeding ewes kept. In summer 40 cattle are grazed, and about twelve fed on cut grass or tares in the courts; 170 hoggs were fed during summer, and a "park" was taken on a neighbouring farm for the ewes and lambs, so that they might get a change, and a few extra cattle were grazed along with the sheep.

C. Specification of Field Gate (CHAP. V. pp. 72–87).—To be constructed of wood and iron, the materials and workmanship to be of the best kind. These are to be sound English oak and best wrought iron gas-pipe. Uprights—back, 4½ inches by 3 inches; head 3 inches by 2½ inches; two central pieces 3 inches by 2 inches horizontal. Top bar, 1 inch gaspipe, with three ½-inch intermediate bars. The top, third, and bottom bars pass through the back and head. The ½-inch bars, being let into the back and head only one inch each—the top, third, and bottom bars are secured by back nuts. Unions are screwed on to the pipes; these supply

the place of the usual eye, and fit on the hooks driven into the hanging post. A strap of half round iron 1 inch by $\frac{3}{8}$ inch is bent round the back at the top and passes diagonally on each side of the gate to the bottom of the head; where it is secured by an iron clip. These braces are secured on both sides the gate by flat iron staples driven in where they cross the wood. This is called the Elvaston Improved Field Gate. Made by estate workmen, the prime cost is 15*s*. It is both light and strong; and, as far as appearance goes, equal if not superior to any other.

D. Specification of Field Pond (CHAP. VI. pp. 88–92).—To be half circular. For 20 acres, the width in front should be 30 feet, and 15 feet across. Commencing the excavation, proceed by descending one vertical to three horizontal. The sides to be cut perpendicular: leaving notches at every 2 feet to key the concrete. The bottom to be covered with a layer of hydraulic lime concrete 18 inches deep; the sides to be lined with 2 feet of the same material to the level of the surface; a second coating 4 inches thick of fine concrete to be spread over the bottom and smoothed over with the trowel. A stone curb, 18 inches deep and 16 inches thick, must be laid the whole length of the front, the top of which shall only project 3 inches above the surface of the ground, forming on the inside an abutment for the concrete. A strong fence shall be placed round the back and sides, to prevent an accident to stock; such fence not to be less than 4 feet from the face of the cutting, trees suited to the locality shall be planted round the pond and securely guarded.

E. Specification of Farm Buildings (CHAP. VII., pp. 93–117).—The following is extracted from a minute of the Land Commissioners for England, having reference to the erection of buildings in England, the cost of which may be charged by an annuity for a term of years on the estate.

"All buildings must be erected in a substantial and durable manner, and no weather-boarded buildings can be sanctioned, except barns under special circumstances. An efficient supply of water must be provided for all buildings, and the source from which it is to be derived must be fully described.

"Three bed-rooms are to be provided in each labourer's cottage; where, however, many are to be built, a proportion with two bed-

rooms will not be objected to. The height of the living-rooms not to be less than eight feet in the clear, and the bed-rooms not less than seven feet six inches; the level of the ground floor to be not less than eight inches above the general surface of the ground outside. Party walls between cottages, when built of bricks, not to be less than 9 inches thick; and in all cases to be carried from the foundations to the underside of the roof covering.

"The sanction of the Commissioners must be obtained before the works are commenced. No deviation from this can be sanctioned."

Attention is called to the following specifications:

"*For Excavator.*—A minimum depth should be given for the footings of the walls, piers, &c., so that the top course shall not be nearer to the surface of the ground than six inches; also the depth of all cesspools, drains, tanks, &c.

"*Drains.*—All drains to be laid with a good and sufficient fall; those for manure not to be less than 1 ft. in 80 ft., and those for water only, not less than 1 ft. in 100 ft.

"*For Bricklayer or Mason.*—The description and quality of bricks to be specified, every header to be a whole brick, and no half bricks or bats used, except as closers to a course.

"The description and quality of stone should be stated; proper bond stones to be built into all walls of their full thickness, so that they shall not be more than three feet apart in any direction.

"Cast iron air bricks to be inserted in all external walls for ventilation under boarded floors.

"*Carpenter.*—In all cases where fir timber is used, that obtained from Memel or Norway, and battens from Dram, St. Petersburg, or other Norway or Baltic Ports, is to be preferred.

"All oak used to be of English growth. No timber to be placed nearer to the inside of any flue than one foot. All timbers to be cut die square, and to hold the scantlings specified when finished.

"Scantlings of Memel or Norway fir, for the timbers of roofs, &c., in the following table, will be sanctioned by the Commissioners:—

Description of Roof.	Span.	Tie Beams.	Principal Rafters.	King or Queen Posts.	Struts.	Straining Piece.	Sill Piece.	Purlins.	Common Rafters.	Wall Plates.	Pole Plates
		in. in.	in. in.	in. in.	in. in.	in. in.	in. in.	in. in.	in. in.	in. in.	in. in.
King Post	18 feet	7½ × 3	5 × 3	4 × 3	3 × 2½	...	...	6 × 3½	3½ × 2	4 × 3	4 × 4
	20 ,,	8 × 3	5½ × 3	4½ × 3	3½ × 2½	...	...	6½ × 3½	3½ × 2	4 × 3	4 × 4
	22 ,,	8½ × 3½	6 × 3	4 × 3½	3½ × 3	...	...	7 × 3½	4 × 2	4½ × 3	4 × 4
	24 ,,	9 × 3½	6 × 3½	4½ × 3½	4 × 3	...	...	7½ × 3½	4 × 2	4½ × 3	4 × 4
	26 ,,	9½ × 4	6½ × 3½	5 × 3½	4½ × 3	...	...	8 × 4	4½ × 2	5 × 3	4 × 4
	28 ,,	10 × 4	6½ × 4	5 × 4	4½ × 3½	...	...	8½ × 4	4½ × 2	5 × 3	4 × 4
	30 ,,	10½ × 4½	7 × 4	5½ × 4	5 × 3½	...	...	8½ × 4½	5 × 2	5 × 3	4 × 4
Queen Post	30 ,,	9 × 4	5½ × 4	4½ × 4	4 × 3	7 × 4	4 × 4	7 × 3½	4 × 2	5 × 3	4 × 4
	32 ,,	9½ × 4	6 × 4	5 × 4	4 × 3½	7½ × 4	4½ × 4	7½ × 3½	4 × 2½	5 × 4	4 × 4
	34 ,,	10 × 4½	6½ × 4	5½ × 4	4½ × 3½	8 × 4	5 × 4	8 × 4	4½ × 2½	5 × 4	4 × 4
	36 ,,	10 × 5	6½ × 4½	5½ × 4½	5 × 3½	8 × 4½	5 × 4½	8 × 4½	5 × 2½	6 × 4	5 × 4

"The trusses in the above table to be about ten feet apart, and the commom rafters fourteen inches from centre to centre; the feet of the principal rafters, &c., to be secured to the tie beams by proper wrought iron straps.

"Joists having a bearing of from 10 to 16 feet, to be $2\frac{1}{2}$ inches in thickness, with 2-3rds of an inch in depth for every foot between bearings, and from 16 to 24 feet, to be 3 inches in thickness, with 5-8ths of an inch in depth for every foot between bearings.

"Trimmers and trimming joists to be at least half an inch thicker than the common joists. Lintels to be generally 3 inches thick; those to all openings more than 3 feet 6 inches wide to have $1\frac{1}{4}$ inch additional depth for every extra foot of opening; all to be the full width of the wall within the reveal, and to have 9 inches of wall hold at each end.

"*For Stairs*, risers and treads in no case to be less than one inch thick; treads not to be under 9 inches in width, and the rise not to be more than $7\frac{1}{2}$ inches from step to step.

"*For Roofs*, all purlins to be in long lengths, and to be placed on the back of the principal rafters, and supported by blocks; no rafters or ties to be notched to receive them; all joinings to occur over a principal.

"Where roofs are covered with duchess or countess slates, the same should not be laid with a lap of less than 3 or $2\frac{1}{2}$ inches; each slate to be fastened with two nails, the laths to be $2'' \times \frac{3}{4}$.

"Nails for slating to be either copper, zinc, galvanised iron, or nails dipped in oil when in a state of red heat.

"The ridges, &c., in all cases to be either covered with lead (6 lbs. to the foot), proper ridge tile crest, set and pointed in cement, or with patent slate ridging with roll, fastened with screws, and set in oil putty.

"*Plumber.*—Flat gutters between roofs, &c., to be laid with lead 7 lbs. to the foot, valleys with 6 lbs. and flashings with not less than 5 lbs. Cast-iron eaves guttering to be provided to the roofs of all buildings, with proper 3 inch down-pipes connected to drains to carry off the water; the guttering and down-pipes to be of metal, not less than $\frac{1}{8}$ of an inch thick; to have two coats of paint before being fixed, and at least one after, all joints to be put together with red lead. The use of zinc for gutters between roofs, &c., will not be sanctioned.

"*Painter.*—All woodwork, &c., usually painted both inside and

out, to have at least three coats of good oil color paint, exclusive of knotting and priming; or to be stained and twice varnished.

"*Ventilation.*—Especial attention is called to providing an efficient supply of light and ventilation, both in dwelling-houses and farm-buildings, and the means of doing so should be fully described in the specification, and as far as possible shown on the drawings.

"All stables, cow and beast-houses, should have ventilation provided in the roofs, as near the ridge as possible, and also, where practicable, long narrow slits should be formed in the gable walls, also near the ridge."

F. Specification of Cottage Building—This specification is from the office of the Land Commissioners for England. It is for the erection of a pair of labourers' cottages in accordance with the plans provided, and with detailed drawings to be furnished as the work proceeds.

"*Excavator.*—The foundations of the various walls and all other necessary excavations, whether for drains and water-pipes or water-tanks to be taken out to the required depths and all superfluous soil removed, the soil from all the rooms on the ground floor to be excavated to the depth of 15 inches; all vacant spaces round the outside walls and foundations to be filled up with earth to the level of the ground line, the whole well punned in with a descent in every direction from the building.

"*Bricklayer.*—All footings to walls to be built with hard burnt bricks with close joints filled in solid and well flushed with mortar; the mortar to be composed of well burnt stone lime, and sharp clean sand in the proportion of one to two; all wall footings to be two feet wide; the outside walls, from the foundations upwards to the plinth to be 14″ work unless otherwise shown by figured dimensions on the plan; to be diminished 4″ in thickness from the plinth upwards by the insertion of a neat blue brick plinth; the walls to be then 9 inches in thickness to the full height. A thick layer of asphalte to be spread over the surface of the second course of brickwork above the footings as a damp course. To form all breaks, splays, quoins, chimney jambs, &c., as shewn on plans, bed and fix all bond timber, lintels, wall plates, &c., turn relieving elliptical arches over all door and window openings in gaged bricks —half inch rise to the foot. The arches of the fireplaces in living rooms to be turned on suitable iron chimney bars; all flues to be

carried up without any abrupt angles and well pargeted throughout; rubbed stone hearths to be fixed in all fireplaces, each to be one foot longer than their respective openings; all window sills to be laid with blue plinth bricks. The whole of the brickwork to be done in the manner of Flemish bond, to be completely laid in, and entirely flushed up with mortar at every course; no four courses of the work are to rise more than one inch beyond the thickness of the bricks; and there shall be no appreciable difference between the soundness and uniformity of surface between the outside and that of the inside work, except where the work is to be plastered, when the joints may be left rough to insure a better key for the plaster. A 4 inch sanitary pipe drain is to be carried from the lowest point of outlet from the house, receiving—from a surface blue brick channel from the scullery—the slops, communicating with a well-built securely trapped cesspool 18 × 18 in. and 2 feet deep. All the rooms on the ground floor to be filled in to the depth of one foot with well prepared lime concrete, on which must be laid 6 inch quarries bedded in lias lime mortar. Slate chimney pieces to be fixed in living room; stone chimney-piece to be fixed in scullery.

"*Joiner.*—Roof: principal tie-beams to be 9 × 3, backs 7 × 3, secured by $\frac{3}{4}$ round iron rod through centre of tie-beam, passing through an iron plate, which clips the backs at the apex; purlines, 7 inches × 3 inches; wall plates, $4\frac{1}{2}$ inches × 3 inches; ridge $5\frac{1}{2}$ × $1\frac{1}{2}$ inches; spars $2\frac{1}{2}$ inches × 3 inches, not more than 16 inches from centre to centre. Rafters to project 1 foot 2 inches, with facia boards. Barge boards to be 11 inches by 1 inch, with 2 inch moulding. Chamber floors to be made of 7 inches × $2\frac{1}{2}$ inches, white deal battens, grooved and tongued with $1\frac{1}{2}$-inch hoop-iron, the ends resting on battens built into the walls, and supported in the centre by a trussed beam. The floors are beaded in the under side, thus saving the expense of a plaster ceiling. Ceiling-joists to bedrooms, 3 × 2 inches. Partitions, 2 × 4 inches, framed and braced. Stairs to be $1\frac{1}{2}$ inches deal, steps and risers on strong carriages, blocked and bracketed, with $1\frac{1}{4}$ plain deal wallstring outside. A 2-inch deal moulded hand-rail, to be $2\frac{1}{4}$-inch wide, sunk for 1-inch square-bar uprights. Outside doors to be $1\frac{1}{2}$-inch ledged, grooved and tongued; all inside doors to be square framed, deal beaded out and square. A 7-inch deal skirting to be planked round kitchen and parlour windows.

"*Tiling.*—Roof to be covered with best Newcastle red tiles, laid double at eaves, laid to a 4-inch gauge, finished with a plain red ridge-tile.

"*Plasterer.*—To plaster 1 coat and set with fine stuff the walls of parlours and the walls and ceiling of bedrooms.

"*Glazier.*—All windows to be glazed with 13 oz. second crown glass.

"*Painter.*—To paint all doors, windows, stairs, and skirtings with three coats of plain colours in oil, besides knotting and stopping."

G. Specification of Roof of covered Yard.—The whole of the roof timber shall be of seconds Memel, and all joiner's work of red deal—free from sap and all other defects, to be sawn die square, having all outer edges taken off to hold its full specified scantling. All beams shall be in one body, and no scarf will be allowed unless specially mentioned. All purlines and plates shall be in long lengths properly halved, lapped, and pinned at joints and angles. The whole of the joiner's work shall be executed in the most workmanlike manner, and shall include all incidentals requisite for the completion of the works.

The whole of the wrought ironwork shall be of the best description, and include all charges for labour to same, in the best and neatest manner. Construct the roofs as shown on drawings and detail sketches. Principals, 12 inches × 6 inches; collars, 9 inches × 4 inches; pole plate, 5 inches × 4 inches; uprights, "one over each principal: and two intermediate," 4 inches × 3 inches, all roughly wrought, the roof to be laid with 1-inch rough roof boarding. Provide and fix wrought all cast-iron work to details hereafter given. Provide and fix to ventilator 7-inch × 1¼-inch wrought and rounded louvre boards.

Cover the roof with Bangor Countess slates, "open slated," on ¾ inch sawn deal laths, nailed with two 1⅝-inch strong zinc nails to each slate. A double course of slates to be provided for the whole length of all eaves.

Provide and fix 5 inches × 4 inches moulded cast-iron gutters. The whole of these gutters shall have all necessary bends, outfalls, stopped ends, &c., and be connected to the drains with 3-inch cast-iron down piping.

Glaze the whole of the skylights to roof with $\frac{2}{16}$th rough rolled glass in two lengths, from ridge to eaves, bedded in putty, and secured by zinc clips.

Cover the ridge of skylights with zinc 16 ozs. to superficial foot, and 16 inches wide, with proper fastenings, in accordance with details to be furnished; also form all gutters, valleys, flashings, &c. to roofs with zinc of similar description; detail sketch to be supplied.

Knot, stop, prime, and paint 3 coats, all wrought woodwork; also paint 3 coats, all ironwork.

H. Specification of Hay Barn.—We add the specification and cost of a cheaply constructed Dutch barn erected by a Gloucestershire landowner who has been good enough to send the particulars.—The roofs of the Dutch barns are corrugated iron 22-gauge. The uprights are larch poles, the lower ends placed on stones. The cross pieces are larch poles split in half. The sides and ends are open.

(1)—34 feet long, 20 feet span, 16 feet to wall plates:—The whole of the iron, including spouting-down pipes, and also fixing and delivering, £21 10*s.*; carpenter's bill, £3 10*s.*; larch poles, including felling and hauling, £4; plinth stones, including fixing, £1 5*s.*; drain, 5*s.*—total, £30 10*s.*

(2)—44 feet long, 22 feet span, 16 feet to plates:—Iron work, £34 10*s.*; carpenter, £4 10*s.*; poles, £7; plinth stones, £1 12*s.*; drain, 5*s.*—total, £47 17*s.*

The yard I am now covering is 59 by 44 feet, 13 feet 6 inches to wall plates. The roof will be in two spans, corrugated iron, 22-gauge, supported on oak posts and plate. The posts will not be squared, but simply small oak trees of a suitable size. Iron work, including spouting and down pipes, also delivery and fixing, £98; carpenter, £6 5*s.*; oak trees, £5 10*s*; drain, 10*s.*; nine plinth stones, at 5*s.*, £2 5*s.*; bricklayer, 12*s.*—total, £113 2*s.* Where there are no buildings, I have built a wall about 7 feet high. My object has been to keep the yard dry—avoiding, as much as possible, making it unnaturally warm. From the cost of the yard should be deducted the expense of pitching and draining a yard, which is necessary in an uncovered yard, also of laying on water, as sufficient will run off the roof into water-troughs. I calculate that the Dutch barns will pay 12 per cent., and the covered yard 17 per cent.

I. Lands Improvement Acts (CHAP. VIII. pp. 118 to 124).—The following is a list of the Acts under the control of the Land Commissioners,—3, St. James's Square, London, S.W.

Companies' Acts.—*The General Land Drainage and Improvement Company*, 12–13 Vict., cap. 91. (England only.) Offices—22, Whitehall Place, S.W. R. E. Hebblethwaite, Esq., Sec.

The Lands Improvement Company. 16–17 Vict., cap. 154. 18–19 Vict., cap. 84; 22–23 Vict., cap. 82; 26–27 Vict., cap. 140. Offices—1, Great George Street, Westminster, S.W. Granville R. Ryder, Esq., Managing Director.

The Scottish Drainage and Improvement Company. 19–20 Vict., cap. 70; 23–24 Vict., cap. 170. (Scotland only.) Offices—20, Hill Street, Edinburgh. Charles Ritchie, Esq., Managing Director.

The Land Loan and Enfranchisement Company. 23–24 Vict., cap. 169 and 194. Offices—22, Great George Street, Westminster, S.W. Thomas Pain, Esq., Managing Director. E. Garrod, Esq., Sec.

Public Acts.—*Land Drainage Act*, 1861. 24–25 Vict., cap. 133. (England only.) Offices—3, St. James's Square, S.W.

Improvement of Land Act, 1864. 27–28 Vict., cap. 114. Offices—3, St. James's Square, S.W.

Limited Owners Residences Act. 33–34 Vict., cap. 56; 34–35 Vict., cap. 84. (England only.) Offices—3, St James's Square.

Limited Owners Reservoirs Act. 40–41 Vict., cap. 31. (England only.) Offices—3, St. James's Square, London, S.W.

The Agricultural Improvements Association. Offices—6, John Street, Adelphi, London, W.C. Matthew R. Bigge, Esq., F.G.S., Secretary. This Association has been formed to assist Landowners who may desire it, in carrying out the provisions of the above three last-mentioned Acts.

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THE END.

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