

REMARKS ON THE AGRICULTURE OF ABERDEENSHIRE.

BY THOMAS SULLIVAN.

No. IV.

IMPLEMENTS.

It appears that when Dr. Keith drew up his agricultural survey of Aberdeenshire, the implements of husbandry were, with few exceptions, of the rudest description, and but very ill-adapted to the purposes they were intended to serve. Since that period (1810), however, much attention has been devoted to this department both by agriculturists and mechanists; the result of which has been that numerous and important improvements have been effected in the construction of all the instruments employed in this county. Several new implements and machines have also been invented or introduced within the last few years; so that it may now be averred, that though there are doubtless some counties much better, there are many worse provided than Aberdeenshire with effective agricultural instruments. All intelligent cultivators being fully sensible that costly and imperfect work necessarily results from the employment of defective implements, no reasonable expense is spared by them in procuring the best that can be obtained. Several useful instruments have recently been introduced from England and the south of Scotland; and the ingenuity of the native mechanics has also been successfully exercised in effecting some decided improvements on the various agricultural implements employed in the county.

In order in some degree to methodise my observations, it may be as well to class the implements and machines in general use under the following heads, viz.—1, Tillage implements; 2, Sowing machines; 3, Barn machines; and 4, Wheel-carriages, or carts. In a brief sketch—as this must necessarily be—it is obviously impossible to present anything approaching a minute description of the various instruments included under the foregoing general heads; my remarks shall therefore be confined to those most commonly employed, and to the principal improvements which have recently been effected in their construction.

I. TILLAGE IMPLEMENTS.—This class includes the implements employed in turning up, pulverizing, and preparing the soil for the production of crops; also those used in the after-culture of potatoes, turnips, beans, &c., and comprehends the

plough, the harrow, the roller, the grubber or cultivator, and the various kinds of horse-hoes.

Ploughs.—No other agricultural implement has undergone greater improvement within the last few years than the plough; and it is but candid to state that that employed throughout Aberdeenshire until a comparatively recent period stood greatly in need of various alterations to fit it for the execution of efficient work. With the swing-plough of the present day, a pair of stout horses can plough deeper, and turn over more ground in the same space of time, than could have been done by a team of eight or ten oxen with the cumbrous wooden implement which was almost exclusively employed here some forty years ago.* The improved iron swing-plough is now pretty generally adopted in this county, and bids fair at no distant period to supersede the wooden kind altogether. The latter is still, however, by far the most common; and its employment is rendered in some degree necessary by the existing condition of much of the arable land. Although it is regarded as a matter of indifference, so far as the working principle of the plough is concerned, whether the frame-work be constructed of wood or of iron, provided the several parts are of sufficient strength to withstand the strains to which they are likely to be subjected, yet the iron instrument is now preferred in improved districts, and has become general wherever agriculture is in an advanced state, as being decidedly superior to the other in point of durability, and in admitting of a neater and more convenient form. When properly constructed, it also works cleaner, and is more manageable in the hands of the ploughman.

The wooden plough is, however, considered to be better adapted than the iron one to the tillage of land in which large stones have to be encountered; and, as was observed in a previous article, detached boulders, some of which are of immense size, exist in many parts of this county. Being found immediately beneath, or protruding

* Prior to the beginning of the present century, the plough used in this county was of a very clumsy and imperfect construction; and was drawn by six or ten horses, and sometimes even so many as twelve oxen.

* See Keith's Survey, p. 163.

through the surface, they constitute a formidable obstacle to the action of the tillage implements. The iron plough is more liable than the wooden one to be deranged or broken by violent shocks, and it is also somewhat more difficult to manage in stony land. Hence the preference generally given to the latter for breaking up waste or heath-ground, which, in Aberdeenshire, abounds with boulders. The larger class of farms are, in many instances, provided with both wooden and iron ploughs, to suit the different kinds of soil, the former being employed on the "outfield" land, the latter on the "infield." The Aberdeenshire wooden plough has the beam and handles of wood, the mould-board and side-plates of cast-iron, and the sole, head, coulter, and share, of wrought iron. The usual price of a wooden plough is 3*l.*; that of an iron plough, 4*l.* 10*s.* Though the former is thus the cheaper at first, it eventually becomes the more costly of the two. The average duration of a wooden plough is six years; consequently, three sets of them will be required during the currency of a nineteen years' lease: whereas, an iron plough, if taken proper care of, will be but little the worse at the expiration of that period. Indeed, the writer has lately been informed of one which has been in almost constant operation during the last thirty-seven years; and all the repairs it has needed, exclusive of new metal and shares, has not cost above 10*s.* The comparatively low price of the wooden instrument is, however, a great inducement to the small farmer, whose capital is, in general, very limited.

Both the wooden and the iron plough are now most frequently drawn by two horses or oxen, yoked abreast; but three, and even four horses are occasionally attached when ploughing beyond the ordinary depth, as is sometimes done when giving the first or winter furrow to stubble-land intended to be in green crop the ensuing season. In breaking up waste ground from a state of nature, a wooden plough of larger dimensions than the common kind is employed, which is generally drawn by six oxen, these animals being found more suitable than horses for ploughing coarse land containing stones, as they pull more slowly, steadily, and equably.

The iron ploughs now employed in Aberdeenshire are in general of the best construction. The utmost attention has of late years been directed to the improvement of this useful instrument; and the ingenuity of our mechanics has been not unsuccessfully exercised in determining the form best calculated to effect the purposes it is intended to serve. Of course those manufactured by different plough-makers differ from each other to a greater or less extent; but the majority of them bear some

resemblance to the Currie or Mid-Lothian plough (described in the "Farmer's Magazine" for April, 1845), more particularly in the form and connection of the working parts. One of the leading characteristics of that instrument is that the *mould-board* is prolonged forward, so as to cover the neck of the *share*, and presents a medium degree of concavity. The share is chisel-pointed, and varies in breadth according to the texture of the land to be ploughed. A long, narrow share is used in ploughing ground that contains a great number of small stones. The majority of the Aberdeenshire ploughs are furnished with what is commonly designated a "chain-bar," which is merely an iron rod extending from the *bridle* to near where the *coulter* is inserted in the *beam*, and is added chiefly with the view of strengthening the latter part of the implement.

Several important improvements have, during the last few years, been effected by different mechanics in the construction of the plough; but in a brief sketch like the present, it is quite impossible to advert minutely to these. The great objects kept in view by the improvers of the implement have been to render it more capable of effecting in a satisfactory manner the various purposes for which it is intended, more easily drawn by the animals, and more manageable in the hands of the ploughman. In order to the attainment of the first of these desirable objects, the relative positions of the cutting parts, viz. the coulter and share, and the form of the mould-board, have undergone considerable alteration, with a view to cut the furrow-slice in the most proper shape, and to lay it over in the most eligible position. For the purpose of lessening the draught, the length of the beam has been much diminished; which allows the moving power, *i. e.* the animals of draught, to be placed nearer the resistance to be overcome: and the breast has been made narrower and more taper, so as to approach as near as possible to the form of a wedge; the advantage of which, in rendering the plough more easily drawn, is too apparent to require any explanation in this place. In order to render the instrument more easily held, or rather, directed, the length of the *stills* has been increased by several inches; and, as these constitute the ploughman's lever, it is obvious that his power over the motion of the implement has been thereby considerably augmented. The *sole* and side plates have also been lengthened a few inches, which evidently serves to render the plough more steady in its progress through the soil.

A few plough-makers in this county have recently constructed what is designated a *friction-wheel plough*, in which a small wheel, affixed between the mould-board and the left stilt, is substituted for the sole, with the view of diminishing the

power required to draw the implement. It is, perhaps, scarcely necessary to observe that a considerable proportion of the draught of the plough is occasioned by the friction of the soil upon the sole-plate and share, arising chiefly from the weight of the instrument; and it is equally obvious that much of this friction is obviated by substituting for the sole a small wheel on which the body of the plough rests. But, notwithstanding the advantage in this respect which a properly constructed friction-wheel plough may be expected to possess, it has hitherto been but little employed in any part of the United Kingdom, although invented, it appears, so far back as the year 1825, by that ingenious mechanic, Mr. Wilkie, of Uddingstone, near Glasgow; nor is it likely to be at all generally approved of in Aberdeenshire. The great objection to its employment arises from its unsteady motion in the ground, in consequence of the absence of the sole, which of course renders it difficult for the ploughman to execute proper work. Besides, it is obviously inadmissible in the ploughing of stony land, which is very common in this county. The wheel, also, is more costly than the sole.

A simple but beneficial improvement on the common plough was effected a few years ago by Mr. Rae, of Ardmiddle, in the parish of Turriff, which has been thus described by himself:—"It occurred to me that an improvement might be made on our common plough for the purpose of stirring up the bottom of the furrow, where, in many soils, there was a considerable depth of good mould, that had lain for ages unproductive: and from the action of the sole of the plough, when ploughed in a damp state, it is skimmed over, and thus rendered more impervious to air and moisture. With a view to get a sort of second coulter attached behind the heel of the plough, by straightening the beam a little, so as to admit of a similar bore to that in which the foremost coulter is fixed, and by a knee upon it, it is made to work in the middle of the bottom of the furrow to the depth of from four to six inches, as may be necessary. Latterly I have improved on it, by having what may be called a shoe or feather of steel attached to the end of it, about two inches wide at the back, tapered to a point, which now stirs up the whole breadth of the furrow. When inserted to the depth of five inches, to make her work steady, a wheel is attached, which being removeable at pleasure, as well as the additional coulters, she then becomes a common plough again."*

Different kinds of the subsoil-plough, and also of the trench-plough, are employed and manufactured in this county; but it is deemed unnecessary to occupy space with any description of these, as

they present, so far as the writer is aware, no peculiarity of construction worthy of being noticed in this place.

The swing-trees, or swingle-trees (as they are indiscriminately termed), for yoking two horses or oxen to the plough, being of the usual form, and most generally composed of wood, need no description. It has been remarked, in a preceding page, that three horses are frequently yoked abreast in ploughing stubble ground intended for green crop; and, with the view of equalizing the draught as much as possible, a very ingenious though simple apparatus is employed by some farmers, which, from its utility and adaptation to the object in view, merits a brief notice in this place. It consists of a combination of compensating levers united to an apparatus of swing-trees. The main swing-tree is usually five feet in length, and of sufficient strength to withstand the force of three stout horses; and the animals are attached in the ordinary manner, by draught-chains, to three wooden trees of the common size. The compensating apparatus, consisting of three iron levers very ingeniously connected, is placed between the main swing-tree and the smaller ones, and is most generally composed of cast-iron. Three horses yoked abreast by means of this apparatus are, it is considered, equally effective as four attached two and two in the usual manner.

Harrows.—The harrow now generally employed in this county is of the improved rhomboidal form, the old rectangular kind being almost entirely abandoned. That formed of wood is by far the most common; but the iron harrow has recently been introduced, and there is every reason to expect that it will become quite general at no distant period. It is much approved of by some farmers, though the price is considerably above that of the wooden harrow. This, however, is counterbalanced by the much greater durability of the iron implement as compared with the wooden one. Another advantage which the former possesses over the latter is, that it is less liable to become clogged with earth and weeds when the ground is damp. The iron harrow is also found to be the more effective in reducing a cloddy surface, and is therefore preferred by many farmers for pulverizing clay soils. Its length is usually four feet, and its breadth three feet five inches. The price is generally 3*l.* 15*s.*; while that of the wooden kind is only 16*s.* to 18*s.* Besides the common seed-harrow to which we have been adverting, each of the large and medium-sized farms is provided with a pair of light wooden harrows, furnished with short teeth, for the purpose of covering in the seeds of herbaceous plants.

riod, the roller almost exclusively employed in this county consisted of a cylindrical piece of granite, attached to a simple frame-work of wood. The usual length is six feet, and the diameter one foot. In conjunction with the harrow, the stone roller is found to be very effective in pulverizing the soil for turnips and other green crops.* Rollers constructed wholly of wood are now, however, very generally employed throughout Aberdeenshire. They are generally six feet in length, two and a half feet in diameter, and divided into two segments, which revolve independently of each other; but the wooden roller, like the stone one, sometimes consists of only one piece; though, as it is almost needless to observe, the bisected cylinder is turned at the headlands with greater ease to the horse, and with less injury to the plants in rolling corn fields in spring or early summer. The soil of this county being in general light, and easily pulverized, cast-iron rollers are but little needed or employed, except in some parts of Buchan and a few other places abounding in heavy clay, where this kind of roller has latterly been resorted to with much advantage. Even Crosskill's far-famed clod-crusher has found its way into Aberdeenshire; and seems well adapted not only for finely pulverizing stiff, tenacious soils, but also for imparting consistency to the old "infield" land, which by long-continued cultivation has been rendered very loose and incoherent, and is therefore liable to be affected to an injurious extent both by the frost of winter and the heat of summer.

Grubbers.—The same circumstance that renders the use of the cast-iron or other heavy roller unnecessary for effecting the pulverization of the soil of the greater part of this county, sufficiency accounts for the grubber not being much resorted to in the preparatory tillage for green crops. The proportion of clay to be met with in Aberdeenshire being comparatively small, the farmers in general experience much less difficulty in adequately pulverizing the soil than those of other quarters in which the land is of a more adhesive character. Some greatly improved forms of Finlayson's harrow are, however, employed in many parts of the county, and the number of this class of implements is rapidly increasing. Kirkwood's grubber, which was introduced some years ago from East Lothian, is also used to some extent in the division of Buchan, where the soil consists chiefly of clay. The grubber is resorted to, on the majority of farms, more for the purpose of dragging up couch-grass (*Triticum repens*) and other root-weeds to the surface, than of producing a fine tilth; though by an efficient implement of

this kind both these desirable objects are simultaneously accomplished. There is, therefore, hardly any description of land, in the preparation of which for green crop the grubber may not be beneficially employed as an auxiliary to the other tillage instruments. If unnecessary for pulverizing, it will, in all probability, be useful for cleansing the soil.

There is another kind of grubber very much used in this county, particularly on the smaller class of farms, and which differs considerably from both Finlayson's and Kirkwood's. This consists of a triangular-shaped frame-work of wood, mounted on low wheels, in which frame-work are inserted a number of coulters, adapted, like Finlayson's, both for pulverizing the soil and for dragging root-weeds to the surface. It is drawn by two horses, and loosens the ground to the depth of from eight to twelve inches.

An implement called a *break*, or *drag-harrow*, is also very commonly employed in this county for loosening, pulverizing, and cleansing the ground while undergoing the preparatory tillage for green crops; and, in the opinion of some farmers, it effects these purposes as efficiently as the grubber. It is similar in form to the common seed-harrow, but much heavier, and of larger dimensions, being intended to reduce cloddy surfaces, on which the latter would have little or no effect. It is formed of wood, and is drawn by two or three horses, according to its weight. The longitudinal bars are formed of the best larch, the crossbars of good ash. In the two-horse break or drag, the longer bars, technically designated "bulls," are commonly 6 feet 6 inches in length, and 4 inches in width by 5 inches in depth. The cross-bars are 3½ inches in width by 1½ inches in depth; and the whole breadth of the instrument is 5 feet 6 inches. There are four longer bars at the distance of 1 foot 4½ inches from each other, and each bar contains five iron teeth, 9 inches in length, beneath the wood. In the drag-harrow for three horses, there are five longer bars, or "bulls," as they are termed, in each of which is inserted five iron teeth, 10 inches in length. The whole length is 8 feet 4 inches, and the breadth 7 feet. The efficiency of this heavy kind of harrow as a pulverizer arises in a great degree from the action of the frame on the surface of the ground. The price varies from 1*l.* 5*s.* to 1*l.* 12*s.*, according to the dimensions.

Horse-hoes.—The implements of this class are such as are employed in the after-culture of potatoes, turnips, and other drilled crops, the object being to cleanse and pulverize the soil in the intervals between the rows during the growth of the plants. The horse-hoes and scufflers generally used in this county differ so little from those of the same

* Price of stone roller, complete—from 1*l.* 10*s.* to 2*l.*

class employed in most other localities, that any detailed description of them would be quite superfluous. The instrument most generally employed for tilling the intervals of potatoes and turnips, which are the principal drilled crops cultivated in Aberdeenshire, consists of a framework of wood, in which are inserted shares and coulters of iron: the beam and handles are also formed of wood. Many of the instruments of this class are now, however, formed wholly of iron, the extremity of the beam being sometimes supported by a low wheel, and the frame so constructed as to admit of expansion and contraction at pleasure, in order to suit drills of different widths. The place of a beam is not uncommonly supplied by a draught-chain, to which the animal is attached, the instrument being thus better fitted for separating weeds from the soil. In the frame are inserted five coulters, or cutters, so arranged as always to move in different tracts. The price is commonly 1*l.* 12*s.*

II. SOWING MACHINES.—This class includes machines for depositing the seeds of turnips, pulse, and occasionally corn, in rows; also a machine for sowing corn and the seeds of herbaceous plants broadcast. These are now so generally employed, and so well known to all engaged in agricultural pursuits, as to render any description unnecessary, more particularly as none of them have originated in Aberdeenshire, those used in the county having been imported chiefly from Leith; and no improvement worthy of notice has recently been effected. The turnip-sowing machines are of the most approved construction, and differ but little from those in use in all well-cultivated districts. Different forms of this useful instrument are now employed, each of which, however, is drawn by one horse, and sows two drills together.

A machine for depositing guano, bone-dust, or other pulverulent manure, simultaneously with the seed, has recently been introduced; but it has been employed only by the larger class of farmers. Most of the small holders and crofters use a turnip-barrow, which is pushed forward by a man, and sows only one row at a time.

The broadcast sowing-machine is now employed to a considerable extent in the sowing of grain and grass-seeds, and bids fair soon to become generally used throughout the county. Its utility consists in the regularity with which it distributes the seeds, in obviating the difficulty and loss necessarily attendant on hand-sowing during high winds, and in effecting a considerable saving of seed. The seeds of clover and other herbaceous plants are very rarely sown by the hand, except on the smaller sized farms, this machine being peculiarly adapted for distributing small, light seeds with the greatest regularity. Formerly it was mounted on only two wheels, from one of which motion was communi-

cated to the distributing apparatus in the interior of the seed-box: it is now generally supported by three wheels, the additional one placed in front, being of much advantage to the animal, particularly in going down a declivity. The corn drill-machine is but very partially employed in Aberdeenshire, the broadcast mode of sowing being practised almost exclusively. But from the results of the trials which have been instituted by Mr. Hay, of Sheathen, near Tarves, and a few others, it appears that the row mode of culture might be adopted with much propriety and advantage on the soft, incoherent "infield" lands of this county, more particularly if infested with weeds, as the intervals between the rows admit of tilling and cleansing the ground by the hand or Dutch hoe during the growth of the crop.

III. BARN MACHINES.—Under this general head are classed the various machines employed for the purpose of separating the grain of corn from the straw, and subsequently from the chaff or husk, or the different thrashing and winnowing machines. It is proper we should begin with the

Thrashing-Machine.—It appears that the thrashing-machine was first employed in this county about the year 1790, but that, like all great improvements connected with agriculture, a considerable period elapsed before it began to be generally used, or its usefulness to be appreciated. At present, however, all, except the very small farmers, have thrashing-machines suited to the extent of their respective possessions, the flail being employed almost exclusively by the crofters or cottagers. As the thrashing-machine is very justly regarded as the most useful agricultural implement that has ever been invented, it is hoped the following observations will not be altogether devoid of interest.* About sixty years ago, several attempts were made in this county to construct a machine for the purpose of thrashing corn, but all proved more or less abortive. In 1790, however, a machine was erected at the farm of Knockleith, from a model of one some time previously invented, or at least greatly improved, by Andrew Meikle, of Knowhead, near Prestonkirk, East Lothian, by which the operation was accomplished in a manner much more satisfactory than on any former occasion. Though clumsy in form and workmanship, it appears that its construction exhibited the leading mechanical principles of the most approved machines of the present day. It consisted of two feeding rollers and a cylinder or drum, with

* The reporter is indebted to an ingenious millwright of this county for many interesting particulars relating to the thrashing-machine and its appendages.

scutchers or beaters (as they are indiscriminately termed) affixed longitudinally on the circumference of the drum, and the requisite gearing for communicating motion to the whole. In this state it remained for several years, until the *shaker*—a very useful and essential appendage—was added, by means of which the labour of separating the grain from the straw was very considerably diminished. The last-mentioned part has undergone various alterations since its first addition to the thrashing-machine. Originally it consisted of merely four vanes or leaves, with a number of short wooden pegs inserted at their extremities. Some were of a square or rectangular form; others were five-sided; but no other kind proved nearly so effective as the cylindrical shaker now generally employed. In many places two shakers are appended to the machine.

Some important improvements were effected in the construction of the thrashing machine shortly after its introduction into Aberdeenshire, by the Messrs. Skene, who, it appears, possessed a very large amount of mechanical knowledge. They originated what are commonly designated the low-drawn mills, now so much approved of throughout the country. The first of this kind which they erected was made in 1809; and though merely a two-horse power, it thrashed, as I am informed, at the rate of six quarters three bushels of corn per hour. In illustration of the comparative perfection arrived at in the construction of the thrashing machine shortly after its introduction, I may mention that in 1799, a machine, propelled by water-power, was erected in the parish of Kintore, in this county, for 31*l.*, including the dam and water-course, which thrashed at the expeditious rate of fourteen quarters per hour. This is stated on the best authority—the aged owner of the machine in question. It is proper to add that it was reckoned a three-horse power. The feeding rollers were 3 feet in length; the drum was 3 feet in diameter, and made eight revolutions for one of the water-wheel, which was 8 feet 8 inches in diameter, and the floats 8 inches in width by 1 foot 4 inches in length. It was what is technically designated an *undershot* wheel.*

Few of the thrashing-machines now erected at double the cost and of double the power of the one just referred to will thrash so much as fourteen

quarters of oats per hour. In fact, the quantity ordinarily thrashed by a two-horse power machine does not exceed three quarters per hour. A machine requiring a motive force of three horses commonly thrashes from five to eight quarters; and a four-horse power is expected to thrash, on an average, about ten quarters per hour; but it may frequently accomplish twelve, and even fourteen quarters. It may not be amiss to insert in this place the dimensions of the principal parts of a thrashing-machine of the latter power, which was recently erected for a gentleman in this county, and is allowed to be of the most approved construction. The impelling-agent is water; the diameter of the wheel is 11 feet; and the buckets are 3 feet 4 inches in width. The feeding rollers are 3½ feet in length; the diameter of the drum is 3 feet 2 inches; and that of the shaker is 5½ feet. A winnowing apparatus, driven by Barker's centrifugal wheel, is attached to the thrashing-machine. Being furnished with two "hoppers," it can be employed in dressing grain either simultaneously with the thrashing or when the machine is not in operation. The cost of erecting the whole machinery was 58*l.* The average rate of thrashing is twelve quarters per hour; and the quantity of water necessary to accomplish this work varies from 1600 to 2000 cubic feet for every quarter, according to the quality of the corn and the length of the straw.

The thrashing-machines employed in this county vary very much in size and power,* in consequence of the great diversity that exists in the size of farms. A four-horse-power machine is commonly used on farms ranging from 150 to 300 acres, a three-horse-power on those varying from 80 to 150 acres, and a two-horse-power on the smaller class of farms from 25 to 80 acres. A machine requiring only the power of one horse to propel it is sometimes resorted to on small possessions of about 20 acres. The grain-crop on holdings under the last-mentioned size is most generally thrashed by the flail; and the cottagers perform this operation in the winter mornings by the light of the lamp, or during inclement weather, when out-of-door labour is suspended. It is supposed that the thrashing-machines at present employed in Aberdeenshire are impelled by an aggregate force of at least 8000 horses: but, owing to the great extent of the

* There are three sorts of water-wheels, commonly known as the *overshot*, the *undershot*, and the *breast* wheel. The first derives its name from the water coming in contact with and passing over the upper part of the wheel; the second, from the water, after impinging on the floats, flowing underneath; and the third, from the water striking at a point in the circumference of the wheel intermediate between the former.

* A simple rule for ascertaining the power of a water-impelled thrashing-machine is to cube the radius of the wheel, multiply the square-root of this by the area of the transverse section of the water where it impinges on the wheel, and divide the product by 6½: the quotient is the horse-power to which the wheel is equivalent.

county, this is a point which it is very difficult correctly to ascertain.

The motive powers employed in this county for the purpose of impelling thrashing-machines are water and horses. The former, as being not only the most economical, but likewise the most effective agent, is, of course, invariably preferred and used wherever an adequate supply of it can conveniently be procured; and as the many hills and dales with which the surface of the county is diversified give rise to numerous rivulets, water-impelled machines are very general throughout Aberdeenshire. The superiority of this power over horses (irrespective of its greater economy) consists in imparting a more uniform motion to the machinery, and in enabling the farmer to thrash and prepare his corn for market or other purposes in all states of the weather, when a sufficiency of water is available. Horse and water power are occasionally employed in conjunction, which, in some situations, is found a very useful arrangement. During the droughty months of summer, the former is put in requisition either by itself or as an auxiliary to the latter, though at other seasons the supply of water may be quite adequate to impel the whole machinery. In order to convey some idea of the comparative advantages of the three modes of propulsion referred to, viz.—by horse-power, water-power, and both conjointly, a great number of farms of different sizes have been selected; and the actual power of the thrashing-machine employed on each having been ascertained, it has been found that on those farms on which animals alone constitute the motive force, one-horse power is required for every twenty-four acres on an average; but that where water alone is employed, one horse-power is found to be sufficient for thirty-three acres; while on those on which both agents are used in conjunction when necessary, the same power is quite adequate for every thirty-four acres of arable land.

The steam-engine has recently been resorted to by a few farmers in this county, for impelling the thrashing-machine; but, for several reasons, this all-powerful agent is by no means likely to be either much or very profitably applied to farm purposes in Aberdeenshire. In the first place, it is more expensive than either horse or water power. As no coal is found in the county, the cost of fuel would amount to a considerable sum per annum in the internal parts, not to mention the original cost of an engine and its appurtenances. And in the second place, this being more a grazing than a corn-growing district, the quantity of grain annually grown on individual farms of even the largest extent would hardly warrant the erection of a steam-driven thrashing-machine. This agent, being vastly superior to horse-power, is generally

preferred and employed in localities (such as the Lothians and Berwickshire) abounding with extensive farms, where coal is abundant and cheap, and where a very large quantity of grain has annually to be thrashed and prepared for market; but in Aberdeenshire neither of these conditions can be said to exist. The steam-engine is, of course, both inaccessible to and unnecessary for small farmers; and to use it with economy, even on large possessions, it is requisite to continue the operation of thrashing throughout a whole day at a time; which in general is neither convenient nor necessary in this part of the country. There are at present, I understand, no more than five thrashing-machines in Aberdeenshire impelled by steam.

The expense of thrashing and dressing grain per quarter varies according to the nature of the motive force employed, the power of the machine, the quality of the crop, and other obvious circumstances. Water, where it can be procured in sufficient quantity for the purpose, constitutes by far the most convenient and economical impelling agent. A most important advantage attending the employment of water-driven machines is, that by them the greater proportion of the crop may be, and in Aberdeenshire generally is, thrashed and dressed in the winter mornings, before the labours of the field could be commenced. The common practice is this:—A part of the barn having been previously filled with sheaf-corn from the stack, the thrashing is prosecuted for an hour or more every morning, beginning about five o'clock, and leaving off at break of day; the servants then breakfast, groom their horses, and begin the ordinary out-of-door business of the farm. The adoption of this arrangement obviates the necessity of stopping the ploughs during the usual hours of labour for the purpose of thrashing—an advantage which it is impossible to secure when horse-power is employed. In order to illustrate the actual and relative expense of thrashing and dressing grain in Aberdeenshire by the different methods usually practised, I shall here introduce separate statements of the cost of the process by water, horses, and the flail, on an arable farm of 220 acres, cultivated according to the six-course rotation of cropping, and producing annually about 440 qrs. of grain. In the subjoined calculations we take the wages at the usual winter rates in Aberdeenshire, viz.—a man at 1s. 6d., a woman at 10d., and a pair of horses at 8s. per day. We shall suppose the thrashing, &c., to be executed during the ordinary hours of farm-labour in each of the cases referred to. It has frequently been found that it requires eleven days of four men and two horses to cart the unthrashed corn from the stack-yard to the barn. On these data we shall now proceed with our calculations.

1. *Water-power*.—The first cost of the thrashing-machine and its appendages is assumed at 90*l.*, and interest is allowed on this sum at four per cent. per annum. The winnowing machine, also, is driven by water, which saves the work of one man. The whole cost of thrashing and dressing 440 qrs. of oats by water-power may be stated as follows, viz.—

To 2 horses, 11 days carting corn to barn, at 4 <i>s.</i> each per day	£	<i>s.</i>	<i>d.</i>
To 4 men, 11 days attending do., at 1 <i>s.</i> 6 <i>d.</i> each per day	4	8	0
To 4 men, 11 days attending thrashing-machine, at 1 <i>s.</i> 6 <i>d.</i> each per day	3	6	0
To 2 men, 11 days dressing 440 qrs. of grain, at 1 <i>s.</i> 6 <i>d.</i> per day	1	13	0
To 1 woman, 11 days assisting at do., at 10 <i>d.</i> per day	0	9	2
To interest on cost of thrashing-machine, &c.	3	12	0
To annual wear and tear of machinery	3	3	0
To oil and repairs	1	5	0

Cost of thrashing and dressing 440 qrs. £21 2 2
 " " " 1 qr. 11½

2. *Horse-power*.—The thrashing-machine is a six-horse power, and is worked ten hours per day, during which forty qrs. are thrashed. Four men are required in the barn—one to unbind the sheaves, one to supply them to the machine, one to remove the straw, and one to riddle and remove the grain as it comes from the first fanners. The original cost of the machine and its appendages is assumed at 90*l.* as before.

To carting corn into barn, as before	£	<i>s.</i>	<i>d.</i>
To 6 horses, 11 days working thrashing-machine, at 4 <i>s.</i> each per day	7	14	0
To 4 men, 11 days attending do., at 1 <i>s.</i> 6 <i>d.</i> each per day	13	4	0
To 3 men, 11 days dressing grain, at 1 <i>s.</i> 6 <i>d.</i> each per day	3	6	0
To 1 woman, 11 days assisting at do., at 10 <i>d.</i> per day	2	9	6
To interest on cost of machine, &c.	0	9	2
To annual deterioration of do.	3	12	0
To oil and repairs	3	3	0
	1	5	0

Thrashing and dressing 440 qrs. £35 2 8
 " " " 1 qr. 1 7½

3. *The Flail*.—Corn is generally thrashed by the flail at a certain rate per qr. The winnowing and dressing of the grain commonly require about double the labour which suffices in either of the two former cases. The quantity which a man is capable of thrashing in a day by the flails depends in a great degree on the quality of the corn; but one qr. is allowed to be the usual rate of thrashing per day of ten hours. The following is a statement of the cost,

according to the customary allowance per qr. in this district.

To carting corn to barn, as above	£	<i>s.</i>	<i>d.</i>
To thrashing 440 qrs. of oats at 1 <i>s.</i> 6 <i>d.</i> per qr.	7	14	0
To 3 men 22 days dressing do., at 1 <i>s.</i> 6 <i>d.</i> each per day	33	0	0
To 1 woman, 22 days assisting at do., at 10 <i>d.</i> per day	4	19	0
	18	4	

Thrashing and dressing 440 qrs. £46 11 4
 " " " 1 qr. 2 1½

It is proper to observe that the cost of thrashing corn by water-power, as given above, is considerably more than the sum usually incurred, since much of the work is accomplished when the servants would be otherwise unemployed. The charge for the horse-power, on the other hand, is rather under the general expense, as the farmers here rarely or never thrash longer than a few hours together, and much time is necessarily lost by short yokings. The preceding observations on the thrashing-machine, &c., having extended to greater length than was intended, my remarks on the other machines belonging to or employed in the barn shall be as compendious as possible.

Winnowing-machine, or Fanners.—It appears that the first winnowing-machine employed in Aberdeenshire was imported from Leith in 1783, and that, so highly was its usefulness estimated even at that period, that not many years elapsed till there was scarcely a farm of any note in the county unprovided with one. A fanner is almost invariably connected with the thrashing-machine (motion being communicated to both by the same impelling power), the function of which is to separate the grain from the chaff, &c., previous to its appearance in the corn-barn. A second fanner, of a somewhat different form, though essentially similar in the main features of its construction, is employed for dressing or finally preparing the grain for market and other purposes. This is also not unfrequently driven by the same power that propels the thrashing-machine, especially where an abundant supply of water is available, motion being communicated to it in the usual manner by means of a leathern belt extending from some part of the machinery. Within the last few years various alterations, and, no doubt, some improvements, have been effected in the construction of the winnowing machine; but no deviation from the general principles has been made; and therefore it is presumed any further notice would be superfluous.

The Hummeller.—Every corn-barn is furnished with a hummeller, for removing the awns from the grains of barley and bear. This instrument is of various sorts. On the smaller class of farms, hand-

hummellers are commonly employed, which are either of a square or circular form, and consist of a number of parallel bars of iron fixed to a frame of the same material. The barley to be hummelled is placed upon the barn-floor, and is freed from its awns by repeated strokes of the instrument. Another description of hummeller, which is very commonly employed in this county, consists of a fluted drum-cover, the diameter of which is half-an-inch greater than that of the drum. The number of flutes varies from thirteen to sixteen, and they are placed at intervals of $1\frac{1}{2}$ inch. Their length is the same as that of the drum. A space of about six inches in width, adjoining the feeding-rollers of the thrashing-machine, is necessarily unfluted, and, by means of a simple contrivance, it can be elevated or depressed as may be found necessary. This sort of hummeller has been in use in this district from a remote period. It costs very little, and is sufficiently effective for ordinary purposes, but occasions some additional work. It is more generally employed in this county than any other kind of hummeller. Another instrument, which is now much used for the same purpose, consists of a cast-iron box about two feet in length, one foot three inches in diameter at one end, and one foot at the other. The box is divided into two halves, the uppermost one being three-sided, the lower circular; and both are firmly screwed together with bolts. The barley to be hummelled is conveyed into the box through a small hopper at the top, and the awns are broken off by the action of a number of flat, thin blades of iron attached to a spindle or shaft of malleable iron revolving within the cylindrical box at a high velocity. The spindle is an inch square; the blades, of which there are two opposite rows, are one inch in breadth by $\frac{1}{4}$ -inch thick, and tapered somewhat towards the points. The velocity of the spindle and its attached blades is 700 per minute. This kind of hummeller is so placed in relation to the thrashing machine as to receive the grain directly from the first fanners. The usual price of this apparatus is £3 3s. The several operations of thrashing, hummelling, and winnowing always proceed simultaneously when barley or bear is being prepared for the market or for seed.

The other instruments occasionally worked in connection with the thrashing-machine are a corn-bruiser and a churn. The former apparatus is employed in bruising oats for horses—a practice which is found to effect a considerable saving in the quantity of grain required for feeding. When a sufficiency of water is available, a churn is not unfrequently worked by this power, and with much convenience and advantage. A separate water wheel of small dimensions is sometimes used for

this purpose, so that the operation of churning may be at any time carried on independently of the thrashing machine and its wheel.

IV. WHEEL CARRIAGES.—The length to which my remarks on the various instruments included under the foregoing heads have extended forbids anything approaching a description of the carriages employed for farm purposes in this county. Nor is a detailed account at all necessary, as they present few peculiarities of construction, and differ but little from those in common use throughout Scotland. The one-horse coup-cart is that most generally employed; but the double-horse cart is also occasionally used in conveying dung to the fields in winter, when the roads through most farms are not often of the best description. It is to be observed that the spurred corn-cart, so generally employed in the Lothians and other parts of the south of Scotland during harvest, is almost unknown in Aberdeenshire, the common coup-cart being made to answer the same purpose by attaching a moveable frame to it.

It may not be out of place to notice under this head a liquid-manure cart of a very approved construction, which was invented a few years ago by Mr. George Morice, Kenmuck, near Keith-Hall. The cask for containing the liquid is mounted upon an axle and wheels, which are attached in the usual manner to a pair of shafts. The machinery for maintaining the cask always in a horizontal position, and for regulating the discharge of the liquid, is both simple and ingenious. At the foremost end of the cart is fixed what is technically termed a "bridle," with a mortice in its centre, in which works an upright bar of iron perforated with a number of holes, and fastened to the cross-bar of the shafts. Attached to this bridle, and within reach of the driver, is a lever, by means of which either end of the cask can readily be elevated or depressed to suit the irregularities of the ground, or in travelling up or down hill. From the circumstance of the cask being maintained in a horizontal position, the weight on the horse's back, as well as the pressure on the discharging apparatus, is always uniform, however uneven may be the surface of the ground. The apparatus at the posterior end of the cask, for regulating the flow of the liquid, is also very simple and effective. The discharging orifice is furnished with a "shutter," which is opened to any required extent by means of a short lever, and attached to it is an iron pipe for conveying the liquid into the spreading box. This short pipe is closed at its outer extremity, but is provided with two apertures, one on each side, through which the liquid, in escaping from the cask into the spreader, diverges equally to both sides. By means of the lever and shutter, the flow of the

liquid can be regulated to any required quantity, while the perforations in the bottom of the spreader admit of being widened or narrowed, as may be found necessary. The spreading-box is commonly seven and a half feet long, but can be made to any required length, and is easily detached from the cart after being used. The wheel-rims are five inches in width, that the grass may not be injured or cut up, and the axle is curved downwards to allow the cask to be kept as low as possible. The weight of the whole cart when the cask (which contains 118 imperial gallons) is full, is 19 cwt. This liquid-manure cart has obtained a prize at each of the annual competitions of the Aberdeen, Banff, and Kincardine Agricultural Association. The inventor is at present attempting some further improvements. The price at Aberdeen is £10 10s.

I have thus, in a rapid and necessarily imperfect sketch, endeavoured to convey some idea of the

principal implements and machines employed by the farmers of Aberdeenshire. To have entered more minutely into descriptive details would have extended this article beyond reasonable limits; I have therefore omitted even to name some useful instruments of different kinds; but the more important of these shall be adverted to when we come to notice the operations in the execution of which they are employed. From the cursory observations that have been made, it will be perceived that the farmers of Aberdeenshire are, upon the whole, pretty well provided with useful and effective implements, though it is admitted that in this respect they are still considerably behind those of some other localities north of the Tweed—a circumstance which unquestionably is attributable in a great degree to the prevalence in this county of small possessions.

AGRICULTURAL AND SCIENTIFIC TRAINING SCHOOL,

KENNINGTON LANE, LAMBETH, NEAR LONDON.

LECTURES ON THE APPLICATION OF CHEMISTRY TO AGRICULTURE, AND ANNUAL EXAMINATION OF THE CHEMICAL STUDENTS.

BY J. C. NESBIT, ESQ., F.G.S., M.C.S.L., &C.

LECTURE III.—ON CARBON, HYDROGEN, AND NITROGEN.

On Friday evening a numerous and highly respectable company, composed of the parents and friends of the pupils, with a number of scientific gentlemen, assembled in the School-room, Kennington-lane, for the purpose of hearing a lecture on Agricultural Chemistry from Mr. Nesbit, and to witness the annual examination of the chemical students. We have, on former occasions, had to report the examinations of the pupils as having been very satisfactory to their parents and friends; but we believe that the knowledge of chemistry exhibited on this occasion by the pupils to have been much more sound and extensive than on any former occasion.

Mr. NESBIT commenced by saying: Ladies and Gentlemen,—I have very great pleasure in appearing before you this evening, for the purpose of explaining a few of the principles of chemical science, and showing you that these can be understood by children, and instruction can be given in them, following the common course of education, without taking anything away from the usual studies, such as languages and mathematics. This lecture is one of the course which I am delivering to the youths before you, on agricultural chemistry; and I thought that I could not do better than give you a specimen of what we do with those youngsters every week, and I shall now address myself to them; for I think I could not do better than show you the manner in which I deal with them. In the last lecture I showed you the agency of oxygen, and that by its

action all substances (vegetable and animal) were decomposed and reduced into their original components. Hydrogen, carbon, and nitrogen are the elements most subject to the action of oxygen. Carbon, or charcoal, is a substance with which you all are familiar. It occurs, united with hydrogen, in the form of coal; and diamond is only charcoal in a state of purity—in other words, diamond is only crystallised charcoal. There are some other forms of charcoal which are very singular: for instance, plumbago; or, as it is called, "black lead." But there is no lead whatever in it; for it is only charcoal containing a small quantity of iron. You are aware that diamond is the hardest of all bodies, and that it is only another form of charcoal. Here is a piece of charcoal from the common gas works. When gas is liberated from coal, it ascends to the top of the retort, and the charcoal or coke is left below. But if the retort be too highly heated, the charcoal from the gas itself becomes deposited on the upper surface of the interior of the retort, and in this state it is harder than steel. Here is a specimen. It will take the teeth out of a file. It is nearly as hard as diamond; and the teeth of a common file will not touch it. It scratches glass; and it approaches more nearly the state of a metal than to any other. This substance is found also in chalk, which is a combination of calcium and oxygen and charcoal—that is, it is a carbonate of lime—and