

IV.

ON THE HORIZONTAL WATER MILLS OF SHETLAND. BY GILBERT
GOUDIE, TREASURER S. A. SCOT.

The water mill of Shetland exhibits a curious example of the survival to our own day of a piece of mechanism, connected with an essential industry of life, of a type so archaic as to be almost wholly unknown beyond its own immediate area, and to be scarcely recognisable by comparison with anything now to be found elsewhere in Britain. And yet, as we shall see, there is reason to believe that this primitive machinery, and such primitive structures as those within which this machinery is still worked in Shetland, were once common, if not universal, in this country, as was the case in Ireland and in the northern parts of the Continent of Europe and elsewhere.

The mills of Shetland have attracted the notice of many strangers, from their diminutive size and the peculiarity of the working apparatus. While, however, they remain before our eyes as a reality of common life in the islands, their specialty is for most part only matter of passing comment; and it will only be when they have become things of the past, as they are already showing symptoms of becoming, that their uniqueness will be recognised, and details regarding them will be prized. For this reason I have obtained a specimen of the whole machinery connected with the motive power, and desire to put on record a more detailed description, with drawings, than has hitherto been given, with such explanations and illustrations as I may be able to bring together, from a variety of sources, regarding it.

At present the mill, small as it is, is a marked, indeed an indispensable, feature in every scene of Shetland life. Near every homestead, on almost every rill capable, with winter rains, of turning its tiny axle, the mill stands, either alone or as one of a series, corresponding as the case may be to the extent and requirements of the more or less sparsely peopled district around. To remove those mills would indeed be to

rupture the whole present economy of existence to many of their owners. In a primitive form of society such as this we can see the force of the prohibition in the Mosaic law: "No man shall take the mill or the upper millstone to pledge; for he taketh a man's life to pledge" (Deut. xxiv. 6, New Version). It is only within the last few years that the erection of a few improved mills on the Scottish pattern in different districts, producing a cleaner and better meal, with less labour, has induced some of the native farmers to prefer these to their own mills, which therefore are beginning to be neglected, and in many instances are falling into decay.

Hitherto single families, or small groups of families in a neighbourhood, have possessed their own mills, inherited from unknown antiquity, but of course repaired, renewed from time to time, as occasion required. When a householder has his own mill, he grinds his corn during the winter season at times suitable to his own convenience. When he holds a mill in common with neighbours, its use is by rotation among them, as by arrangement may best suit individual requirements. The corn, after being prepared, is conveyed to the mill in *boudies* (or *bödies*), a kind of straw creel, either by ponies in pannier fashion, or by the owner himself. Many a long day or night he watches the slow process of grinding, or he may leave the mill temporarily to its own guidance, when he has calculated the requisite supply of corn in the *hopper* for a given time of grinding, returning to regulate it with a fresh supply. But though alone with the clack of the *clapper*, and the monotonous buzz of the whirling millstone, I am assured that those waiting hours are seldom dreary. And often these hours are whiled away with songs and tales and jests, when more than one are present, as many natives now scattered over the world can well remember in their own experience. In popular superstition, the imp or demon Brownie often got the credit of supplying the corn to the "eye" of the upper mill-stone in the absence of the owner.¹

NOTICES OF THE SHETLAND MILL.

Before attempting a description, with drawings, of the machinery and appliances, from the specimen submitted, it may be well to quote some

¹ *Shetland Fireside Tales*, pp. 134, 135.

notices of the Shetland mill, by the more prominent writers whose attention it has attracted. Some of these notices perhaps scarcely deserve transcription, but they all possess a certain value, and for the sake of completeness they are given in full, in the order of time:—

1. *Low's Tour through the Islands of Orkney and Shetland* in 1774 (Kirkwall, 1879):—"Here [Sound, near Lerwick], I saw the first Shetland mill for grinding oats and bear, but this it does in but a clumsy manner, little better than a handmill or quern, only it saves hand labour. It consists of a very simple set of machinery; a small horizontal wheel for the water to play on, the top of its axis runs thro' the lower and supports the upper stone as in other water-mills; a hopper and shoe with a leaver to level the upper stone, completes the apparatus" (p. 74). (See fig. 1, p. 260.)

2. *The Statistical Account of Scotland*, 1793, Parish of Unst. Drawn up from communications of Thomas Mouat, Esq. of Garth, and the Rev. James Barclay:—"The water-mills, like the ploughs, are of a singular construction. They are without wheels. A round piece of wood, about 4 feet in length, and fitted with twelve small boards, in the same manner as the extremity of the exterior wheel of an ordinary mill, with a strong iron spindle fixed to its upper end, supplies the place of a wheel in these mills. The iron spindle, passing through the under mill-stone, is fixed in the upper. A pivot in the under end of the *tirl* (the piece of wood above mentioned) runs in a hollowed iron plate. The water falls upon the *awes* or feathers of the *tirl*, at an inclination of between 40 and 45 degrees. The mill-stones are commonly from 30 to 36 inches in diameter. The *tirl* occupies the same situation under this mill as the trundles in the inner part of an ordinary mill, and it performs the same office. The diameter of the *tirl* is always equal to that of the mill-stone" (vol. v. p. 182).

In Sir John Sinclair's *View of the General Agriculture of the Shetland Islands*, 1795, where an account of the native mill might have been looked for, it is not referred to.

3. *Tour through some of the Islands of Orkney and Shetland*, by Patrick Neill, A.M. (Edin., 1806):—"In the neighbourhood of

Belmont [in Unst], I had an opportunity of viewing a Shetland water-mill. It was truly an awkward piece of machinery. The wheel, a very trifling one, was placed horizontally instead of vertically; consequently it could do but little work. The wheel had about a dozen of small float boards, placed in a slanting direction, at an

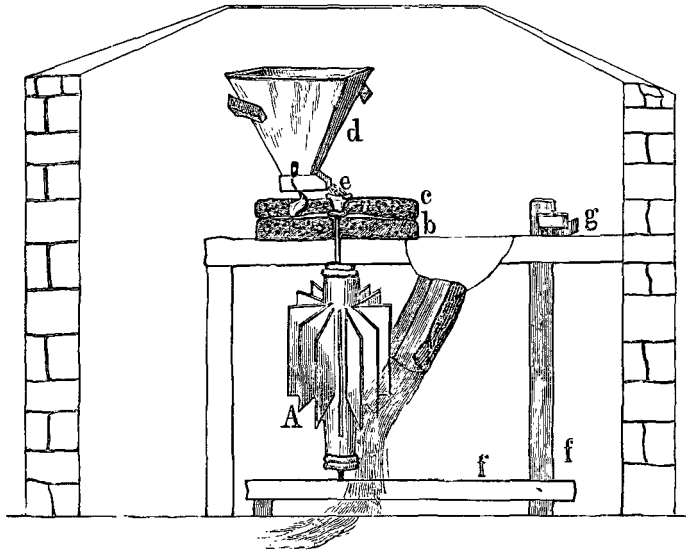


Fig. 1. Diagram of Shetland Mill (from Low's Tour).

A, the Water Wheel; b, the Under Stone; c, the Upper Stone; d, the Hopper; e, the Shoe, for restraining the corn lest it should run too fast out of the Hopper; to it is fastened a small log of wood, which, striking upon the unevenness of the stone, makes the corn run out; f, f, the Leaver; g, its Wedge. (Page 74.)¹

angle perhaps of 40 degrees. The water striking these boards revolved the wheel. An iron spindle, passing through this wheel, through the eye of the under mill-stone, was fixed in the upper.

¹ I am obliged to Messrs W. Peace and Son, Kirkwall, publishers of Low's Tour, for the use of this woodcut.

The mill-stone (blocks of micaceous schistus found in the neighbourhood) were about 3 feet in diameter" (p. 78).

4. *View of the Ancient and Present State of the Zetland Islands*, by Arthur Edmonston, M.D. (Edin., 1809).—The author, a native, contents himself with quoting the description from the *Statistical Account* of the parish of Unst given above (No. 2).

5. *General View of the Agriculture of the Shetland Islands*, by John Shirreff (Edin., 1814):—"The water-mills used in Shetland, like the ploughs, are different from those used in Britain, though it may be remarked that they are constructed precisely upon the same principles as those that are used in Scandinavia at the present day. They are without wheels. A stout cylindrical post of wood, about 4 feet in length, standing perpendicular, and fitted with twelve small boards, inclined so as to receive the impression communicated by the water which falls from above, gives motion to the upper mill-stone by means of an iron spindle fixed in the upper end of the post, which, passing through a hole in the under mill-stone, is firmly wedged in the upper one. The mill-stones are commonly 30 to 36 inches in diameter" (p. 37).

6. Sir Walter Scott, when visiting Shetland in 1814 as one of the Commissioners of Northern Lights, with the usual keenness of his eye, caught sight of the native mill, his impressions of which he records as follows:—"The upper end of the little lake of Cleik-him-in [near Lerwick] is divided by a rude causeway from another small loch, communicating with it, however, by a sluice, for the purpose of driving a mill; but such a mill! The wheel is horizontal, with the cogs turned diagonally to the water; the beam stands upright, and is inserted in a stone quern of the old-fashioned construction. This simple machine is enclosed in a hovel about the size of a pig-stye—and there is the mill! There are about 500 such mills in Shetland, each incapable of grinding more than a sack at a time" (*Diary*, 4th August 1814).

This personal acquaintance with the Shetland mill was afterwards turned to account in the Romance of

7. *The Pirate* (Edin., 1822)—Triptolemus Yellowley, the Scottish factor, *loquitur*:—"Can a man," rising to enthusiasm as he spoke, "or even a beast, look at that thing there, which they have the impudence

to call a corn-mill, without trembling to think that corn should be intrusted to such a miserable molendinary. The wretches are obliged to have at least 50 in each parish, each trundling away upon its paltry millstone, under the thatch of a roof no bigger than a bee-skep" (chapter xi.).

In a note it is added—"Had Robinson Crusoe ever been in Shetland, he would have had no difficulty in contriving a machine for grinding corn in his desert island. These mills are thatched over in a little hovel, which has much the air of a pig-stye."

8. *Description of the Shetland Islands*, by Samuel Hibbert, M.D. (Edin., 1822). Dr Hibbert was not at the trouble to produce a new description, so he patched up a medley of some of the preceding, and completed his *crib* by reproducing, without acknowledgment, Low's drawing, which has been already given (p. 260). (Low's work was not printed for more than half a century afterwards.) Dr Hibbert remarks that, "compared with a water-mill of Scotland or England, the grinding apparatus of Shetland seemed designed for a race of pigmies." And "the invention of this exquisite piece of machinery is probably as old as the time of Harold Harfagre" (*Iter.*, iii. p. 466).

9. *The New Statistical Account of Shetland*, by the Ministers of the various Parishes, 1841-1845.—The native mill is scarcely alluded to in these reports. The minister of Unst remarks:—"The water mills for grinding corn are the same as they have been for centuries, exceedingly simple, but answering the purpose very well. Every neighbourhood has its own mill, and every farmer is his own miller" (p. 40). The Rev. John Brydon, minister of Sandsting and Aithsting, says, that "there are about 50 mills in the parish, and querns or handmills without number" (p. 115).

10. *Voyage round the Coasts of Scotland and the Isles*, by James Wilson, F.R.S.E., M.W.S., &c. (Edin., 1842):—"We had this day [in the island of Unst] an opportunity of inspecting one of the primitive mills of Shetland. The grinding stones, usually formed of micaceous schist, are placed upon a framework, and beneath a roof. A strong iron spindle is wedged into the upper stone, and passing through a hole in the centre of the lower one, is firmly fixed into the upper end

of a strong wooden post; at the base of which are mortised, in a slanting direction, a number of flat boards forming the cogs of a kind of horizontal wheel. A trough from a natural rill of water is made to convey the moving power upon the wheel, which turns the upper mill-stone slowly round, and so grinds the grain, supplied either by an old straw basket or other rustic hopper, or more patiently by human hands" (vol. ii. p. 322).

This description is accompanied by a woodcut fairly accurate, but showing the structure as grotesquely diminutive.

11. *Art Rambles in Shetland*, by John T. Reid (Edin., 1869).—The author gives a drawing of the old mill near Scalloway, reproduced on page 268 of this paper; also separately of the *tírl* (fig. 5, p. 269), not altogether accurate in details, but sufficient to convey a general impression.

12. *Shetland and its Inhabitants*, by Robert Cowie, M.D. (Edin., 1871):—"The water-mill peculiar to the country is a straw-thatched hut of the most primitive construction, and the smallest size calculated to admit human beings. The wheel is arranged so that the water is projected against it horizontally, and not perpendicularly, as in mills whose architects have rightly estimated the force of gravity" (p. 159).

13. *Shetland, an Ecclesiological Sketch*, by Unda (T. S. Muir), privately printed 1862.—In this pamphlet (p. 8), Mr Muir gives a sketch of "a road-side country mill, Cunningsburgh."

14. *The Agriculture of the Islands of Shetland*, by Henry Evershed, Sussex, Prize Essay, Highland and Agricultural Society—*Transactions*, 1874:—"There are burns in every township, and a mill to every half dozen families. The volume of water is, of course, in proportion to the small distance the burn runs before finding the sea, and the size of the vertical water wheel is adapted to that of the rivulet. The mill is built, like all other structures, of stones or turf, the only abundant and ever-present material of construction. Like the houses and all other buildings, it is thatched with feals, or strips of turf, weighted with stones for security against storms. No portion of the materials is purchased, except a single clamp of iron, which is fixed in the running stone. Five or six families co-operate in the building of a mill, and

they may become its owners a few days after the foundation stone has been laid," &c. (p. 197).

15. *The Past in the Present*, by Arthur Mitchell, M.D., LL.D., *Rhind Lectures in Archaeology* (Edin., 1880).—In this work Dr Mitchell describes the Shetland Mills as follows:—"They are driven by horizontal wheels, the floats or vanes which receive the impulse of the

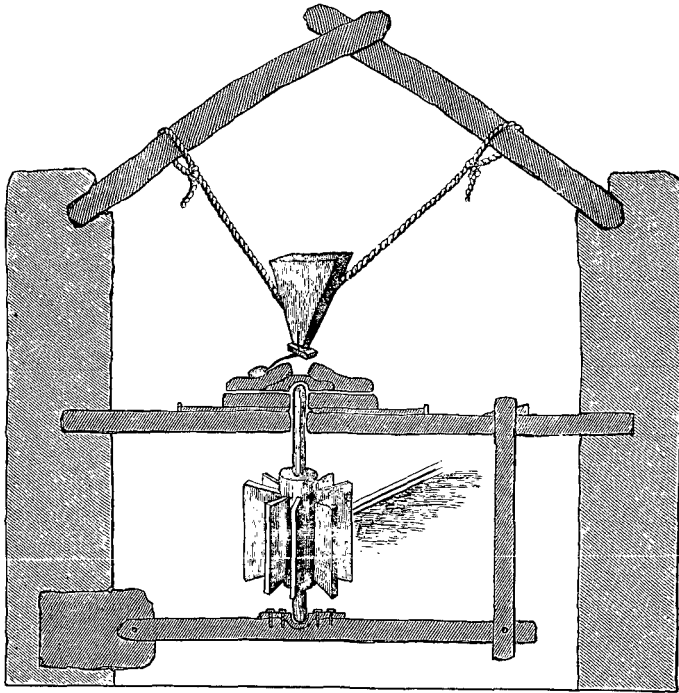


Fig. 2. Diagrammatic Section of Shetland Water-Mill.

running water being fitted obliquely into a sort of nave on the spindle. The motion is thus given directly to the mill-stone. In other words, no change of motion is necessary. The lower end of the spindle, which is generally shod with iron, turns usually in a stone socket, but sometimes in a socket of iron. The upper mill-stone is fed from a hopper hung

from the roof by straw ropes. To the hopper is attached a feeder, which receives a vibrating motion from a stone fastened to it by a piece of string, and lying on the surface of the upper mill-stone, the roughnesses of which, as it goes round, make the string irregularly tight and slack, as the result of its varying drag. This mode of giving the proper motion to the feeder is as clear as it is simple. The mill-stones deliver the meal on the floor all round them on a space marked off by a low ledge of wood."

Dr Mitchell measured the door of one mill as $2\frac{1}{2}$ feet wide by $4\frac{1}{2}$ feet high. His rough diagrammatic section, which I am permitted to reproduce here (fig. 2), shows the whole apparatus distinctly. Some of the parts are not altogether the same in form as in any native specimens I am acquainted with. The suspended *hopper* is disproportionately small. Frequently, instead of, as in this case, being hung by straw ropes, it is fixed to one cross tree or secured between two cross trees from side to side of the roof. The *clapper*, in place of, being a stone attached by a string, is usually a piece of wood so fixed as itself to strike, and give a vibrating motion to, the *shoe*, causing a steady supply of corn to run out.

16. *The Orkneys and Shetland*, by John R. Tudor (Lond., 1883). The description here (p. 151) is brief, and presents no new feature. Finally, an article in

17. *Good Words*, for November 1884, gives a view of the interior of a Shetland mill, which is only a caricature. The mill-stone is shown to be driven by a small cog-wheel, revolving alongside, on the top of the *tirl* or spindle.

II. THE MILL AND ITS PARTS.

The Shetland mill possesses more than a merely antiquarian interest. It has a kind of scientific value, besides, as a curious specialty in hydro-mechanics. In Ferguson's Lectures, published in 1764, brought down to date by Brewster in 1806, it is stated, that "although horizontal water-wheels are very common on the Continent, and are strongly recommended to our notice by the simplicity of their construction, they have almost never been erected in this country, and are therefore not described in any of our treatises on practical mechanics." The author

then describes the horizontal wheel, with a drawing showing the motive power communicated to the upper mill-stone by the cog-wheel system, instead of the simple Shetland method of carrying the stone directly around upon the spindle of the water-wheel.

In the same way, none of the other authorities on the horizontal wheel, whom I have had the opportunity of consulting,¹ appear to have been cognisant of the mill of the Shetland type. It is the fact, nevertheless, that many hundreds of these horizontal mills were at work in Shetland in their own day, and I think we shall find reason to believe that mills of similar construction were at one time common also in every part of the country. But, whatever the extent of the area of the horizontal mill may in former times have been, it is in Shetland, almost exclusively, that we now find it in actual operation. It is therefore, as it exists in Shetland, that it can be most accurately described, and that an indication is afforded us of what its use and working may have been elsewhere.

The mill in Shetland is always placed in the most convenient spot, in or near a township (*tún*), for obtaining a good water supply. As a rule, ordinary running streams can be depended upon for this purpose only when there is an abundant rainfall. Whenever possible, therefore, a burn proceeding from a loch, or from a pond formed by a rude embankment, is preferred for steadiness of supply. From the nature of the case, the mills work only in winter. During the rest of the year the streams are often dry; and, besides, the scanty stock of grain is exhausted. What is not turned into meal in the winter grinding, is carefully preserved for seed; and when the seed is in the ground in the *voar* (spring) the next season's supply must be waited for.

The mill itself, as has been shown by preceding descriptions, is no larger than is absolutely necessary, and is sometimes exceedingly diminutive, an object of curiosity and surprise to the stranger. An ordinary size may be 12 to 17 feet in length by 10 to 12 feet in

¹ *On Horizontal Water-Wheel, especially Turbines or Whirl Wheels*, by Moritz Ruhlman, edited by Sir Robert Kane, Dublin, 1846. *Expériences sur les Roues Hydrauliques à axe vertical appelées Turbines*, par Arthur Morrin, Metz, 1838. *Mémoires sur les Roues Hydrauliques à aubes courbes mues par dessous*, par M. Poncelet, Metz, 1827.

width; walls, 4 feet to 5 feet high and about 2 feet thick; height of gables, 6 feet to 8 feet. Actual measurements of one example, a mill at Sound, near Lerwick, are given on page 278.

While the archaic character of the Shetland mill has so long been noted and commented upon, no specimen of the working apparatus has until now found its way to the Museum. So long as it remains before our eyes in actual operation, the preservation of any part of it has not been regarded as an object of urgency, or the opportunity of securing it has not presented itself. When in Shetland in the summer of 1883, I succeeded in possessing myself of the portable machinery, *i.e.*, the *tirl*, or water-wheel, and its accompaniments, *viz.*, the *sole tree*, the *lightening tree*, the *sword*, and *sile*. These are now before the meeting, and I have the pleasure to present them as additions to the numerous objects of antiquity from Shetland already in the Museum. They will be described in their proper order. The *tirl* and gearing was bought, in its place, from Hans Leslie, Milligarth, in the parish of Dunrossness, the owner, who had made it for himself not many years before; and it may not be uninteresting to record that the cost to me of this working machinery of a mill, as it stood, was the not exorbitant sum of six shillings and sixpence! The mill in which this machinery did duty is one, now fallen into decay, of nine on the burn between the Loch of Clumlie and the sea at Trosswick, in the parish of Dunrossness; some of these belonging to individual farmers, others to a few neighbours, who use them jointly in rotation, as formerly explained.

The mill and its parts may perhaps be not inconveniently described in the following order, *viz.*, (1) The Structure; (2) The Prime Mover; (3) The Grinding Apparatus.

I. THE STRUCTURE.

Under and Upper Chamber (Under-house and Upper-house)—

Floor—Walls—Roofs—Openings.

The following drawing (fig. 3), of the mill near Scalloway, is by Mr John T. Reid (*Art Rambles in Shetland*, 1869). I have not been able to obtain the dimensions of this mill. As supplying an

extensive neighbourhood, it is larger than the average size; and, architecturally, it is also considerably in advance of the ordinary type, the wall of the under-house showing an arch, instead of the flat lintel, which is perhaps universal. It was, when sketched, somewhat dilapidated, and is now roofless. The mills at Sound, shown in figures 4 and 6, are average examples.

The *under-house*, or lower chamber, is the portion of the mill, under-

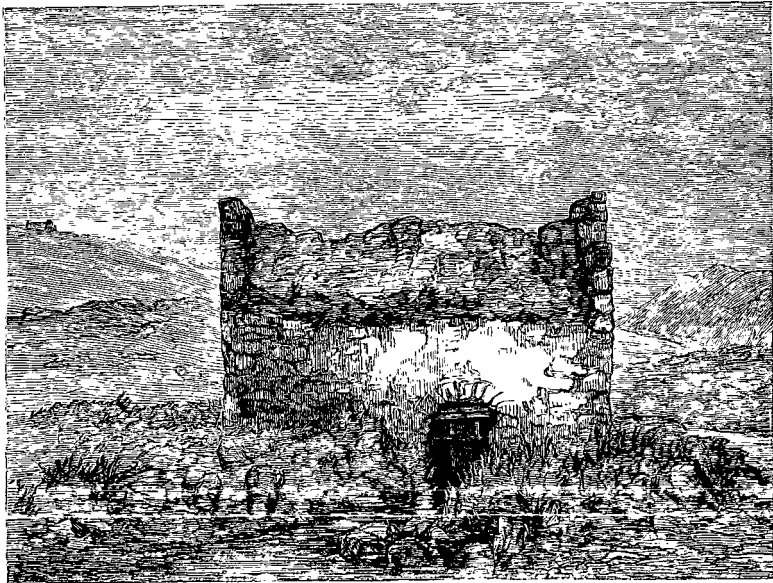


Fig. 3. Old Mill near Scalloway.

neath the ground level, where the water-wheel, or *tirl*, works. It is usually at one end of the structure, but sometimes in the centre, as may, in the natural disposition of the ground, be most convenient. When at the end, one of its sides is formed by the lower part of the gable wall. The other side is built at a distance of from $3\frac{1}{2}$ feet to 4 feet. The back wall of the structure forms its back; and its front, on the lower side of the mill, is always entirely open. The under-house

is thus an open space, extending across the whole width, underneath the mill floor, of varying height and breadth, but usually about 4

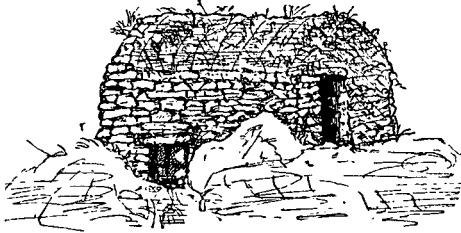


Fig. 4. Mill at Sound, near Lerwick (from a Sketch).

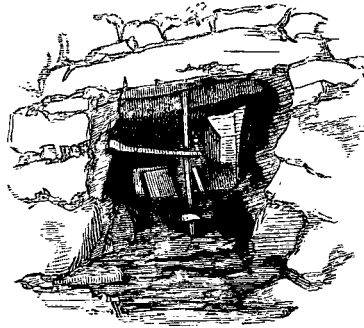


Fig. 5. View of Under-House and Tirl (from a Drawing by Mr John T. Reid).

feet either way, or nearly so. The back wall is pierced by the small nearly square opening formed to admit the lower end of the trough,



Fig. 6. Mill at Sound, near Lerwick (from a Photograph).

where it discharges the water upon the *tirl*. The roof is made of stout flags, which form the floor of the *ludr* or meal-house above.

The *upper-house* is the mill proper, forming a single apartment. It

is built partly over the *under-house*, or lower chamber, and partly upon the solid ground, because, as just explained, the lower chamber occupies only a portion of the area.

The floor of the *ludr*, upon the centre of which the mill-stones rest, is formed by the flagged roofing of the under-house, and is either a slightly raised platform or is marked off from the rest of the mill floor by a small setting of stones. The outer floor is merely the natural earth levelled and compacted.

The *walls* are of stone, $1\frac{1}{2}$ to 2 feet in thickness, the upper part of the gables being frequently of turf, for economy of material and labour.

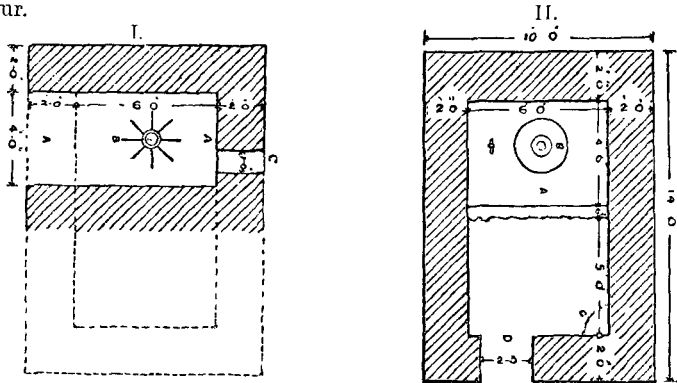


Fig. 7. Ground Plans of (I.) Under and (II.) Upper House. I., AA, Under-House ; B, Site of Tirl ; c, Opening for Trough ; II., A, *Ludr* or Meal-House ; B, Mill-Stones ; c, Fireplace on Floor ; +, top of *Lightening Tree* ; d, Doorway.

The *roof* is set with couples and tie beams (locally "cross-balks") and is covered with turf ("divots"), secured with ropes of straw.

The *door* is, almost invariably, in one of the gable ends, opposite to the mill-stones ; and it is the only opening, except occasionally a small roof-light let into a thin flagstone, and, it may be, an aperture in the roof for the egress of smoke from a small peat fire on the outer floor in the corner (c).

2. PRIME MOVER.

Mill-Lade—Sluices—Trough—Tirl and Spindle, and Appliances.

As the water supply is usually scant, the stream, when the position conveniently admits of it, is provided with a dam, or rude embankment on a higher level at some distance above the mill, so as to form a small reservoir or mill-pond. Some of these ponds and embankments are of great antiquity. The mills themselves, of less substantial construction, are more liable to decay, and have been more frequently renewed.

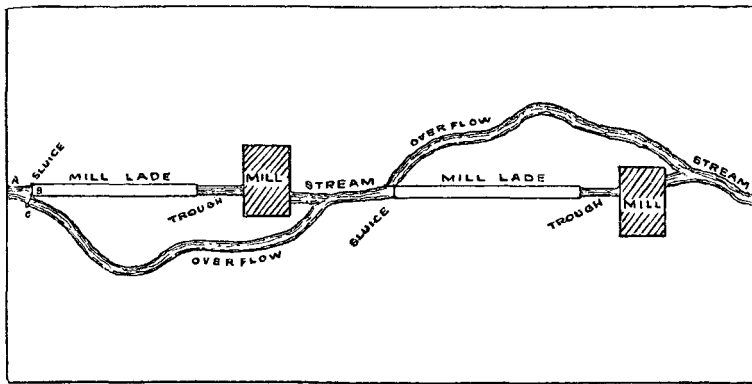


Fig. 8. A, the Stream ; B, Kluse ; C, Sluice.

As shown by the above diagram, the water forming the motive power in setting the mill in motion, and keeping it in work, is diverted from the stream A, by opening the sluice B, termed the *kluse*, and at the same time shutting down the *by-board* of the sluice C, to prevent escape to the natural stream. The whole volume is then conducted towards the mill in the prepared *lade*, terminating in a wooden *trough*, down which it rushes with augmented velocity, and discharging upon the water-wheel (or *tirl*) sets the grinding apparatus in motion (see fig. 9). Sometimes, as a further protection to the mill against a sudden outburst of water upon it, or the failure of the *kluse* effectually to shut it off, a

second kluse-board is sometimes placed at the junction of the lade and the trough, either with or without a separate overflow to the stream.

The waste water thrown off by the wheel (or *tirl*) in the *under-house* again forms a junction with the stream. If there are more than one mill on the stream, a second mill-lade with sluices is constructed, as shown in the diagram, when the same process of diverting the water, using and discharging it, is repeated as often as there are mills requiring it. By this method, each one of the mills is independent of the others. Each intercepts and utilises the water supply when it is required; when not required, it is simply shut off, and passes on, to be diverted by the next mill in succession requiring it. This is well illustrated by the Ordnance Survey Map of the parish of Dunrossness, which shows nine mills on the burn of Trosswick.

When the water is scarce, and economy in its use requisite, it is not uncommon for as many of the mills on a stream as may be convenient to take advantage of the supply at one and the same time. This is sometimes done at night, which indeed is the favourite grinding time, the water being allowed to accumulate in the loch or reservoir during the day.

The *sluices*, as has been indicated, are formed of wooden boards sliding in grooves made in the structure of the mill-lade.

The *trough* is always of wood, about 10 or 12 feet long, 12 to 14 inches wide at the top, contracting to 6 or 7 inches at the lower end, and 12 to 14 inches deep, also diminishing as it approaches the lower end. It is pitched at a slope usually of about 40° . The *fall* varies from 3 to 4 feet. The position of the mill-lade and trough, and the mode of discharging the water upon the *tirl*, will be seen from the following section of the interior of a mill of average size (see fig. 9).

The Tirl and Spindle.—This, the best known and most characteristic part of the Shetland mill, shown in preceding drawings, may be more fully described in connection with the specimen *tirl* before the meeting (see fig. 10):—

The solid wooden centre piece or nave, termed the *tirl*, through which the spindle passes, is 1 foot 9 inches high, 7 inches diameter

The feathers are, in this instance, fixed perpendicularly; more frequently they are placed in an oblique or slanting direction. The upright *spindle* or axle, made of iron, passing through the wooden block or *tirl*, is 4 feet in length. Its formation, where it passes through the block, and at the upper end where it is fixed in the *sile*, and carries round the mill-stone, is rectangular in section. If its form had been rounded, it would have failed to answer its purpose,

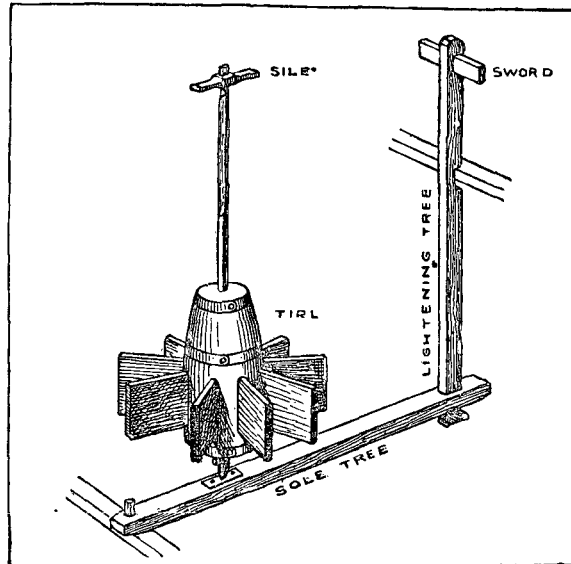


Fig. 10. Tirl or Water-Wheel and Adjuncts (drawn by Mr J. Romilly Allen).

as, in that case, it would itself have revolved within the centre of the tirl, instead of being fixed within it, and carrying it around with it. In many cases the iron axle is made in two pieces, one end of each flattened in the form of a *tang*, and driven into the ends of the wooden nave, instead of passing wholly through it. This simple method obviates the difficulty of having to bore through the entire length of the block. An iron pin is inserted through the axle immediately

below the wooden nave, to keep the nave fixed, without the risk of its slipping down on the axle. The *tirl*, when in motion, is always made to go with the sun, *i.e.*, from left to right.

Bolster-head.—The wooden beam placed along the back wall of the under-house, forming the rest, or support, for the inner end of the sole tree.

Sole-tree.—This, termed also the *under-balk*, is the beam upon which the tirl stands. Its inner end is fixed with a wooden pin, upon the centre of the bolster-head, from which it stretches forward at right angles. Near its centre is fixed the *ground-sile* or *ground-keeng*, the iron plate on which the lower end of the spindle revolves.

Lightening-tree.—The upright beam fixed from the outer end of the sole-tree, passing through the mill floor. It is a simple contrivance for raising or lowering the upper mill-stone, so as to produce a finer or more coarsely ground meal. The lightening-tree is kept steady in its place by the *cross-tree* or *guy-tree*, stretching across its centre about half way up its perpendicular length, from side to side of the open front of the under house.

The Sword (locally *Swerd*).—The little cross bar of wood which passes through the head of the lightening-tree on the surface of the mill floor. By the insertion of wedges underneath it, the lightening-tree is raised or depressed, as may be desired, with the consequent raising or lowering of the mill-stone, and the production of a coarser or finer meal.

Sile.—Size $9\frac{3}{4}$ in. by $1\frac{5}{8}$ in. and $\frac{3}{4}$ in. thick at the centre, from which it gradually diminishes to a thinner flattened surface towards either end. The sile is the small iron bar fixed across the under side of the *eye* of the upper mill-stone, in checks cut to receive it on either side of the opening. The upper end of the spindle or axle passes through a rectangular opening in the centre of the sile, and the sile, resting in its checks, carries the mill-stone along with it when it is turned by the spindle.

Grütte.—The nave of the under mill-stone, made of wood or cork, through which the spindle passes to the *sile* in the upper mill-stone.

Ground-keeng or *Ground-sile*.—The small iron bar or plate fixed in the *sole-tree*, forming the socket of the pivot of the axle. Two, frequently three, holes or depressions are made in it to receive the pivot. When one of these depressions is too deeply worn, the ground-sile may be slightly shifted and another depression or socket hole used. The origin of the term *keeng* is uncertain.

3. THE GRINDING APPARATUS.

Mill-Stones—Hopper.—Shoe—Turning-Pin—Clapper.

The *lightening-tree*, the *sword*, the *sile*, the *grütte*, and the *ground-sile*, which are immediately connected with the grinding process, have just been described along with the *tirl* and *spindle*, with which they are also directly associated.

The mill-stones are of native stone, worked in the islands, and not imported. The size of course varies. The usual diameter is about $2\frac{1}{2}$ feet to 3 feet. The upper stone is usually slightly concave on the lower side. The grinding surface of both stones is renovated from time to time by sharpening with a pick. Diagonal grooves, so far as I am aware, are not known. The removal of the *sile* from the eye of the upper mill-stone prevents the possibility of the stones being set in motion. It is, consequently, sometimes taken away to guard against interference with the mill surreptitiously.

I have not ascertained the number of revolutions of the mill-stones in a minute, or the quantity of corn ground in a given time.¹ This is of course graduated by the volume and impulse of the water power, and the size and condition of the mill-stones. It may be sufficient to say that the rapidity of motion is not great, and that the grinding power is only moderate. But, nevertheless, the mill and its performance are, in the native eye, the reverse of contemptible; indeed the mill-stones and horizontal wheel, when at work, are a little formidable, and had better not be carelessly approached.

The millstones are not enclosed in any covering or casing, as in

¹ I have been since assured, on good authority, that an ordinary mill will grind a bushel of meal in an hour.

modern mills. The meal, as ground, is delivered upon the floor all round the perimeter of the stones. It is carefully collected, and conveyed to the homestead in the native straw *beudie* in which the corn was brought to the mill.

The *Hopper*.—This, which is common everywhere, is the wooden box or trough, containing the grain to supply the mill. It is square in form; wide a-top, and contracting towards the bottom, where it enters

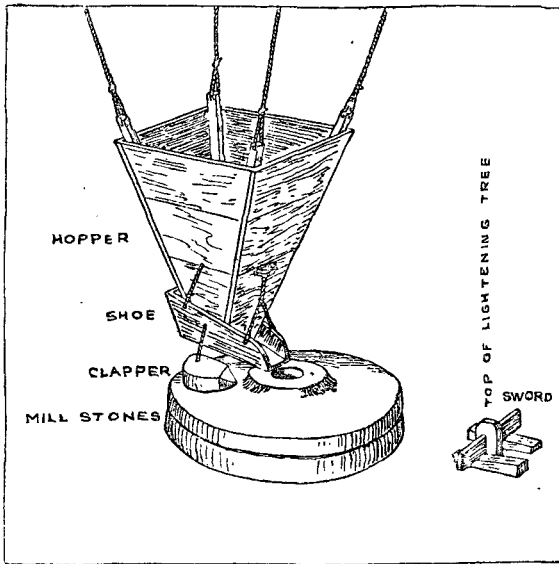


Fig. 11. Hopper, Shoe, Clapper, &c.

the *shoe*. It is fixed to cross-trees in the roof, or hung upright over the mill-stones by ropes from the rafters (see fig. 11).

The *Shoe*.—Small wooden box, open in front, and without lid or cover; fixed beneath the open lower end of the hopper, to transmit the corn to be ground from the hopper to the eye of the upper millstone (see fig. 11).

The *Turning-pin*.—The quantity of corn supplied to the eye of the

mill-stone is regulated by the *turning-pin*. The pin is fixed in the front of the hopper, and a cord from it is fastened to the *shoe*. The tightening or slackening of this cord, effected by the mere turning of the pin, elevates or depresses the open front of the *shoe*, and causes the corn to run out more or less rapidly, as may be desired (see drawing of Hopper, fig. 11).

The *Clapper*.—This is a piece of wood attached by a cord to the side of the *shoe* (see fig. 11). Resting partly upon the upper surface of the mill-stone it is shaken by the rapid motion of the stone, and constantly striking the *shoe*, it communicates its own vibrating movement to it, and causes the continuous outflow of the grain to the “eye” of the stone, which is known as “feeding” the mill.

In supplement to the above general descriptions, I am enabled to submit the following dimensions, from careful measurements supplied to me by Mr James M. Goudie, of a mill at Sound, near Lerwick, viz. :—

| | |
|---|--------------------------------------|
| Length of mill, outside, . . . | 14 feet 4 inches. |
| Width “ “ . . . | 10 feet 6 inches. |
| Height to top of gable, . . . | 6 feet 6 inches. |
| Inner half of floor (<i>Ludr</i> or “meal house”), | 6 feet by 5 feet 10 inches. |
| Outer end of main floor, . . . | 6 feet by 5 feet 6 inches. |
| Thickness of walls, | 2 feet 3 inches. |
| Doorway, | 4 feet 2 inches by 2 feet 3 inches. |
| Under house, | 3 feet wide by 3 feet 8 inches high. |
| Diameter of mill-stones, . . . | 2 feet 11 inches. |
| Eye of mill-stone, diameter, . . | 4½ inches. |
| Nave of tirl, | 22 inches. |
| Feathers (9), | 15 by 11 inches. |
| Trough—length, | 13 feet. |
| “ —breadth, | 15 inches, diminishing to 7½ inches. |
| Height of sides, | 13 inches, diminishing to 12 inches. |

I am also able, in concluding this part of the paper, to place, side by side with the names of various parts as known in Shetland, the names still preserved in remote parts of Norway, and the equivalent terms in Gaelic. For the Norwegian names I am indebted to a native gentleman,

Mr J. F. Myhre, late of Christiania, who has taken the trouble to trace them out from provincials whose dialect, even at the present day, is very different from the standard Dano-Norwegian. The Gaelic names have been supplied by Mr Alexander Mackay, from his early knowledge of the mill at Kirtomy, in Sutherland, now in ruins, referred to at pages 282, 283.

NAMES OF PARTS OF THE HORIZONTAL MILL.

| <i>Shetlandic.</i> | <i>Norwegian.</i> | <i>Gaelic.</i> |
|-------------------------------|-------------------------------------|---|
| Sole-tree or under-balk. | Lettetre or Grundskida. | ... |
| Grund-keeng or grund-sile. | Grunnmusa. | ... |
| [Lower point of spindle.] | Pik (<i>i.e.</i> , Pike). | [Entire spindle] iarunn mhòr (big iron). |
| Tirl. | Kall or Kvenkall. | Bodach-a-mhuilinn (old man of the mill). |
| Feathers. | Spjeld or Fjöl. | Sgiathain (wings). |
| Spindle. | Spenol or Spenvol. | ... |
| Sile. | Sigle. | Crascan an iarunn mhòr (cross of the big iron). |
| Grütte. | Grötte. | |
| Ludr. | Ludr (Icelandic or Old Norse). | Leibhinn. |
| Overstane (upper mill-stone). | Oversten. | Clach-uachdair. |
| Understane. | Understen. | Clach-iòchdair. |
| Eye. | Kvein-auga (eye). | Suil (eye). |
| Hopper. | Kveintina or Tina. | Treabhailt or sleaghag. |
| Clapper. | Skaketein (Old Norse, Skakmöndull). | Clabhan. |
| Shoe. | ... | Brog (boot). |
| Lightening-tree. | ... | Each (horse). |
| Trough. | ... | Amair (trough). |

III. AREA OF THE USE OF THE HORIZONTAL MILL.

In the archæology, and in the rural life of Shetland at the present day, we find exhibited all the most primitive processes of corn-grinding with which we are acquainted. These are—(1) the ancient *rubbing-*

stone, with the stone which was worked upon it; (2) the perfected *hand-quern*, with rotary motion, at present in use. There is, lastly (3), the *water mill*, with horizontal wheel, and appliances, as already described. This, highly primitive as we regard it, is nevertheless the supreme and most efficient effort, in its own way, of the simple form of civilisation which it represents. The Scottish corn mill, with vertical wheel, undershot or overshot, and cogged spur-wheel, trundle, and gearing, now introduced into the islands, is the outcome of a race and an era altogether different in character; and the steam mill, stationary or travelling, is something beyond the range of the natural vision of the native eye. Shetland therefore, *per se*, in this particular respect, has not advanced beyond the limit of her civilisation in the Scandinavian era.

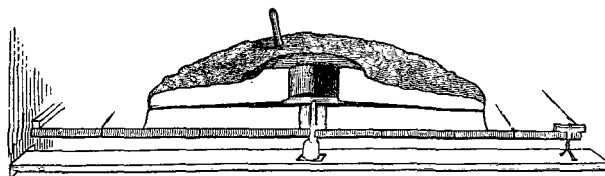


Fig. 12. Shetland Hand-Quern—Sectional View.

Though evidence is scanty, the probability is that the methods of grinding have developed everywhere in much the same way as in Shetland. We know that the hand quern was in use in the East in early times; but it would appear from Latin authors that pounding corn in mortars was in use in Italy so late as the beginning of the Christian era, and that water mills were not introduced before the time of Julius Caesar. What the form of mill may have been at that time cannot be determined. No attempt appears to have been made to trace the process of advancement from early forms, and there is therefore, as yet, only room for conjecture. The similarity of the word for mill in many European languages has been pointed out by Irish antiquaries,¹ and is certainly curious, viz. :—

¹ *Ulster Journal of Archaeology*, vol. iv. p. 8.

| | | |
|-------------------------------|------------------------------------|--|
| Icelandic, <i>mylna</i> . | Bas-Breton, <i>milin</i> . | Finnish, <i>müllin</i> . |
| Danish, <i>mölle</i> . | Irish Gaelic, <i>muileann</i> . | Hungarian, <i>malom</i> . |
| Swedish, <i>möll</i> . | Scottish Gaelic, <i>muileann</i> . | Albanian, <i>muli</i> . |
| Frisian, <i>mellen</i> . | Manx, <i>myyllin</i> . | Greek (ancient), <i>μυλν</i> . |
| Dutch, <i>molen</i> . | Lithuanian, <i>malunas</i> . | „ (modern), <i>μυλες</i> . |
| Old German, <i>mulin</i> . | Bohemian, <i>mlyn</i> . | Latin, <i>mola</i> , <i>molendinum</i> . |
| Modern German, <i>mühle</i> . | Polish <i>mlyn</i> . | Italian, <i>mulino</i> . |
| Swabian, <i>mülin</i> . | Wendish, <i>mlon</i> . | French, <i>moulin</i> . |
| Anglo-Saxon, <i>miln</i> . | Russian, <i>melynaca</i> . | Spanish, <i>molino</i> . |
| Welsh, <i>melin</i> . | Illyrian, <i>malin</i> . | Walloon, <i>molin</i> . |

This tells significantly of the kindred origin and the universality of the mill, but conveys no indication of its form at any time, or in any place.

Corn mills were in use in Scotland at any rate in the thirteenth century, and they appear to have been introduced into Ireland at a much earlier date. The very ancient Brehon laws prescribe the damages incurred by the miller in case of accidents in a mill turned by water. Under date A.D. 561, the Annals of Tighearnach contain an entry alluding to a mill; and there are traditions referring to mills at an earlier period in that country.

The horizontal water mill, as we now find it in Shetland, is a more restricted subject of inquiry than that of the corn mill in general. Almost obliterated as it is elsewhere, it is here still to be found in extraordinary numbers. In the parish of Dunrossness, from which the specimen exhibited was procured, the Ordnance Survey map shows at least thirty-six. According to the New Statistical Account, there were about fifty in the united parishes of Sandsting and Aithsting. It has been estimated that there were lately as many as 500 in the different parishes and isles.

But while Shetland is thus, at the present time, the special home of this horizontal mill of primitive construction, the area of its use, at any rate in former times, cannot be limited to those islands. I have endeavoured to find traces of it in other quarters, with some success, though the literary material to be overhauled in the search is very varied and diffuse.

(A) GREAT BRITAIN AND IRELAND.

Orkney Islands.—The horizontal mill must have been common in Orkney at one time as well as in the sister group of Shetland, and its rapid and complete disappearance there is remarkable. It is not alluded to, so far as I have observed, in Wallace's or Barry's Histories, nor in the Old or New Statistical Accounts, or in any other authorities on Orkney. But Mr J. W. Cursiter, F.S.A. Scot., Kirkwall, informs me that the remains of one on the hillside of Birsay, called a *Clack Mill*, are still to be seen, and this is confirmed by information gathered by Mr John Gunn, H.M. Inspector of Schools.

One out of the thirty-three special heads of complaint by the inhabitants of Orkney and Shetland against Lord Robert Stewart, in the year 1575, was his "taking away sucken fra the auld outhal [udal] mills of Orkney, whilk were observit of before inviolate." *Sucken* is defined by Jamieson as the jurisdiction attached to, or the duties paid at, a mill; and though the precise meaning in this instance is not very clear, it may be inferred that Lord Robert had erected mills of his own, to which he had astricted the people, compelling them to pay multure to him, and relinquish the use of their own mills. The mention of the "old udal mills" of the country is, in any view, curious, and seems indubitably to point at a primitive native system of corn grinding of which no other notice is, so far as known, preserved, and which has passed almost entirely out of memory in Orkney.

Caithness and Sutherland.—"In the Caithness district [of the parish of Reay] are ten water mills, and in the division of the parish belonging to Sutherland, four. In each district, too, there is also a *highland mill*, having but one horizontal wheel immediately under the mill stones" (*Statistical Account of Scotland* (Sir John Sinclair's), parish of Reay, by the Rev. David Mackay, vol. vii. published 1793, p. 576).

The old horizontal mill was thus known on the northern mainland of Scotland at the end of last century, and a *highland* origin ascribed to it. No such mills now exist; but I have obtained from Mr Alexander Mackay, 20 St Andrew Square, a full account of one at Kirtomy, near Swordly, in the parish of Farr, Sutherlandshire, which was in working

order in his early days. From his description, the construction of the mill, and the details of the grinding apparatus, were almost exactly the counterpart of those of Shetland, and particulars need not therefore be repeated. Dr Arthur Mitchell informs me that, on 24th October 1864, he saw this mill, which became ruinous about eighteen years ago. A few days later, he saw another of the same kind at Kinloch-Bervie, about 2 miles from Rhiconich.

The mill at Kirtomy, according to Mr Mackay, was covered with *divots* (Gaelic, *foid*), and thatched with straw held together by ropes made of heather stretched lengthwise and across, and held down at the eaves with stones. A fireplace was on the ground, against the north gable, with a hole above it in the roof for the partial egress of smoke.

The points of differentiation from the corresponding parts of the Shetland mill are as follows, viz.:—(1) Four wooden beams were fixed at right angles along the sides of the under-house, or water house, forming a square frame. Across the centre of this square was placed another beam, in the middle of which the pivot of the *bodach* or water-wheel worked. This framework and cross beam seem to correspond with the ancient timber framework, found embedded in the soil, which puzzled the Irish antiquaries, as will be afterwards mentioned (see p. 289). There is nothing precisely analagous to this in the Shetland mill, where we have only two beams at the foundation level, in the form of the letter T, namely, the *bolster-head* beam at the back, with the *sole-tree* projecting from its centre at right angles, and bearing the upright *tirl* or water-wheel. (2) The wooden *bodach* (Shetland, *tirl*) is said to have been 4 feet high and about 12 inches thick. In Shetland it is usually shorter, but including the iron spindle, it comes to be of the same dimension. (3) The *sgiathain* or “feathers” are long, about $2\frac{1}{2}$ feet, in their projection outward from the *bodach*, and concave in form, in order to get the impulse of the water more effectually. In Shetland the feathers are much shorter, about 13 to 15 inches as a rule, and they are usually 8 to 12 in number, in place of 16, as in this case, and they are never concave. (4) The iron bar or clasp, fixed on the under side of the upper mill-stone, was four-armed, thus X, the spindle piercing it

at the centre. In Shetland the *sile*, as it is termed, is usually only a single iron bar.¹

Outer Hebrides.—"The expense of a Highland mill is no obstacle, as it does not amount to a great many shillings. The stones are about 3 feet in diameter, the upper being fixed in a vertical axis that passes through the lower, and through the floor of the hut, which is built on the edge of a rock or bank over some stream. The axis is about 4 feet long, working on any casual stone by an iron pivot—the only iron in the whole construction. Sixteen or eighteen rude sticks, scooped at the outer ends like a spoon, are driven horizontally into it, their flat sides being vertically placed to catch the stream directed against them. The hopper is suspended by four strings from the roof of the hut, which is scarcely sufficient to contain a man upright. It would not be easy to construct the horizontal mill on cheaper terms" (M'Culloch's *Western Isles of Scotland*, vol. ii. p. 30).

"In Lewis there are numerous small mills of singularly rude construction. The wheel, consisting of a few flat boards, revolves horizontally. Its axis, passing through the nether, is fixed into the upper mill-stone, which it causes to revolve. The mill is fed by a hole in the upper stone. The parish of Uig can boast of having eight mills on one brook, but they are mills of the above construction" (Mr Macgillivray "On the Present State of the Outer Hebrides," Prize Essay, Highland and Agricultural Society, *Transactions*, New Series, vol. ii. 1831, p. 299).

"The mills in Lewis are probably the greatest curiosity a stranger can meet with on the island. There is scarcely a stream along the coast, on any part of the island, on which a mill is not to be seen. These mills are of a very small size, and of a very simple construction. The water passes through their middle, where the wheel, a solid peice of wood, generally 18 inches in diameter, stands perpendicularly. A bar of iron runs through the centre of this wheel. This bar of iron, or axle, rests on a piece of steel which is fixed on a plank, the one end of which is fixed in the mill wall, the other in the end of a piece of plank which stands at right angles

¹ Mr Mackay has since described the Kirtomy Mill in the *Celtic Magazine* for August 1886.

with the plank on which the wheel rests. The upper end of the axle fits into a cross bar of iron, which is fitted into the upper mill-stone, which is rested upon wooden beams or long stones. There is a purchase upon the end of the said perpendicular beam or plank, by which the upper mill-stone can be raised or lowered. There are nine pieces of board, 8 inches broad and $1\frac{1}{2}$ foot long, fixed in the wheel, parallel and at equal distance from each other, upon which the water is brought to bear; which, together with a few sticks for roof, and some heather for thatch, constitutes a Lewis mill" (*New Statistical Account of Scotland*, Parish of Lochs, by the Rev. R. Finlayson, 1845).

I have made inquiry in Lewis as to whether such mills still exist, and am informed that several of them are still in occasional operation, notably in the parishes of Barvas, Lochs, and Uig. Two or three are said to be seen at times at work on a burn in the face of a brae near Valtos, in the last named parish. (Letter from Mr Kenneth Mackenzie, banker, Stornoway, 23rd March 1886.)

Mr Duncan Macdonald, who is intimately acquainted with the Harris district, has described to me an old mill which he has frequently seen in use in the island of Taransay. I am indebted to his kindness for the carefully executed model now exhibited. Notwithstanding slight variations, it may be said to be scarcely distinguishable from the ordinary Shetland mill.

Mr Alexander Carmichael, an authority on all matters relating to social economics and local characteristics in the Western Isles, tells me he has seen several such mills at work in Harris and the Lews.

Island of Mull.—In the parish of Kilninian "there are eight corn mills, whereof three are of the ancient simple construction, in which there is but one wheel, and it lying horizontally, in the perpendicular, under the mill-stone; so that the water to turn it must come through the house. These are called black mills" [misprint for *Clack*-mills?]. (*Statistical Account of Scotland*, Parish of Kilninian, by the Rev. A. M'Arthur, vol. xiv. p. 149 (1795).

The Lowlands.—Thus far the clear and indubitable references to the ancient horizontal mills, in Scotland, are confined to Shetland, Orkney, Caithness, Sutherland, and the out-lying Western Isles of the Lews,

Harris, and Mull. Though written evidence is not ready to hand, I do not despair of finding enough, in the course of time, to show that its use was common all over the Lowlands, as well as in Highland districts and the Isles. In 1793 the Rev. John Ramsay, writing of the parish of Kirk-michael, in Ayrshire, in the *Statistical Account of Scotland*, says that "in nothing has this part of the country received greater improvement than in kilns and mills. Formerly the latter were miserable machines, at which much time was consumed, and the grain horribly abused"—certainly an indefinite reference, but one that seems nevertheless to point to something like the primitive structures we are treating of.

It has been mentioned that in Orkney the old horizontal mill was termed a *clack* mill. In the island of Mull it bore the same designation, if the term *black* mill, which appears in the account of the parish of Kilninian, be, as I have supposed, a misprint. In Jamieson's Dictionary *clack* is explained as the "clapper" of a mill, and *clack-mills* are alluded to in connection with that explanation. The old mansion known as Clock-Mill House, contiguous on the east to Holyrood Palace, and removed some years since, is mentioned by Maitland in his *History of Edinburgh*, 1754, as the "Clack-mill-house."¹ An Act of the Lords of Council and Session, 7th May 1569, in defining the boundaries of the girth or sanctuary of Holyrood, expressly mentions a mill as standing at that place, on the stream proceeding from the Nor' Loch by the North Back of the Canongate. It is therefore no unwarrantable conclusion that in our near neighbourhood, on this stream which is now a main drain of that quarter of Edinburgh, debouching in the Craigen-tinny meadows, a mill of the old primitive type in question was situated in early times, for the use of the monks of Holyrood or of the citizens in that quarter, or of both, ere the Canonmills, on the north side of the city, came to be the principal mills of the brethren of Holyrood and their tenants.

About the year 1128 David I. granted to the Abbey of Holyrood 26 acres of land, with the right of erecting a mill thereon ("volo etiam ut idem canonici habeant libertatem molendini faciendi in eadem

¹ "The gutter or channel in the Horse Wynd going eastwards to the Clack-mill-house" (*History of Edinburgh*, Maitland, 1754, book ii. p. 153).

terram"); also one of his mills of Dene (Dean), and a tithe of the mills of Liberton and Dene, and the new mills of Edinburgh. It is not improbable that the clack-mill at Holyrood may have been the mill for the erection of which authority was thus given seven hundred and fifty years ago, but the wording of the grant is too vague to admit of identification with certainty. It is clear, however, that the very limited water supply on the Canongate burn (north bank) could never have turned a mill of other than the most light and primitive description; and though it may have been improved in style, and doubtless been swept away long ago, the old name lingered (as the clack-mill) until, in comparatively recent times, the more dignified appellation, as it was considered, of the "Clock-Mill" House was assumed by the mansion which rose upon the property. A clack-mill, with hopper and "clapper," and presumably also the horizontal wheel, on this spot at the headquarters of civilisation in Scotland, seems sufficient warrant for our assuming the possible existence of such mills anywhere else in Scotland or in England.

It is difficult to arrive at any definite conclusion as to the construction and equipment of mills in early times, from the lack of sufficiently detailed description, so far as known to me. Some slight indication may be gleaned from the following conditions of the "setting" of the mills of Edinburgh to Alexander of Turing for two years in 1466; the said Alexander "biggand the said mylins of his awin expensis in this maner; the twa hous of the mylne with stane and lyme, ekand the lenth of ilk hous xx fute of lenth and in breid xx fute within the wall, and loft the twa hous sufficiently and mak a chimney in the wall of ilk mylne besyde the hopper, and the durris with hewyn stane."¹

At an early date mills received exclusive privileges. In the reign of Alexander III. (1249-1286) we find a statute of the guild prohibiting any one from grinding "*frumentum mastilionem vel ciliginem*" at hand-mills, unless compelled to do so by stress of weather, or lack of water mills.

It is apparent that, for however long mills of the primitive type remained in use in certain districts, structures and machinery of a more advanced kind were not uncommon, at least for three centuries back.

¹ Extract from *Burgh Records of Edinburgh*, 1403-1528, p. 22.

In 1590 Robert and James Ker, with sundry other "broken men," were pursued by the Earl of Morton and the tenants of Langnewton on the charge that they "schamefullie brak the stanys quhellis [stones and wheels] and utheris ornamentis of the said mylne [of Langnewton], and careit away with them the hail irne grayth thairof."¹ These expressions could not be used in reference to the equipment of the primitive horizontal mill.

Isle of Man.—“Many of the rivers (or rather rivulets) not having sufficient water to drive a mill the greatest part of the year, necessity has put them on an invention of a cheap sort of mill, which, as it costs very little, is no great loss though it stands six months in the year. The water-wheel, about 6 feet in diameter, lies horizontal, consisting of a great many hollow ladles, against which the water, brought down in a trough, strikes forcibly and gives motion to the upper stone, which by a beam and iron is joined to the centre of the water-wheel” (Gibson’s *Camden*, Isle of Man, vol. ii. p. 1448).

England.—It has been seen (p. 265 *ante*) that the horizontal principle of mill construction was unknown, a century ago, to leading authorities on mechanics as having been at any time in use in England. But a statement which I at one time took note of from Green’s *Conquest of England*, on the authority of *Doomsday Book*, that there were 264 *winter mills* in the one county of Dorset, seems to suggest that these were small mills of the kind in question upon minor streams eight hundred years ago. The quotation is from memory, and is subject to correction. Readers of Chaucer may have observed the reference in the *Clerke’s Tale*, written five hundred years ago, to the tongue of the masterful wife, which “ay clappeth as a mille,” an expression of some significance viewed in the light of the present inquiry.

Ireland.—It has been shown (p. 281 *ante*), by a reference to an entry, under date A.D. 561, in the *Annals of Tighearnach*, that water mills were known in Ireland at an early period, but were those of the horizontal type? The evolution of industrial appliances of this kind elsewhere would seem to warrant the presumption that they were so, and there is archæological evidence pointing in that direction. The

¹ *Register of Privy Council*, vol. iv. p. 505.

following extract from the Montgomery MSS., dated 1698, proves the existence of this primitive form of construction two centuries ago, or at no great distance before that time :—“ I conclude with a few remarks more, viz., that from the said long bogg ” [beside Newtonards, in the county of Down] “ issue many rills and streams which make small brooks (some of them almost dry in the summer), that run to the sea on each side of the upper half barony ; and on them each townland almost had a little miln for grinding oats, dried in potts or singed and leazed in the straw, which was the old Irish custom, the mealle whereof called *greddane* was very cours. The milns are called Danish or ladle milnes ; the axel-tree stood upright, and the small stones or querns (such as are turned with hands) on the top thereof ; the water-wheel was fixed at the lower end of the axle-tree, and did run horizontally among the water ; a small force driving it. I have seen [some] of them in the Isle of Man, where the Danes domineered as well as here in Ireland, and left their customs behind them ” (“ Montgomery MSS.,” p. 321 ; *Ulster Journal of Archæology*, vol. iv. p. 13).

The strange circumstance is that in the course of time the knowledge of this primitive mill completely passed away, and not even a tradition regarding it seems to have remained. Several discoveries having, however, been made before the middle of the present century, by the side of running streams, of timber framework buried several feet beneath the surface, also mill-stones, wooden troughs, stocks or shafts with mortises for the insertion of the fans of wheels, &c., the question was once and again brought before the Kilkenny Archæological Society, in the years 1849 and 1850, and discussed as one of almost mysterious antiquity. It was finally concluded that those relics were the remains of water mills of an early age, probably the eleventh or twelfth century.¹

It was some years later, in 1856, that the subject was exhaustively dealt with in a paper by Mr Robert MacAdam in the *Ulster Journal of Archæology* (vol. iv. p. 6). Mr MacAdam submitted a drawing reproduced here (fig. 13) of a water-wheel found several years previously,

¹ *Transactions of the Kilkenny Archæological Society for 1850*, p. 154.

and then in the possession of Mr James Bell of Prospect, near Ballymoney.

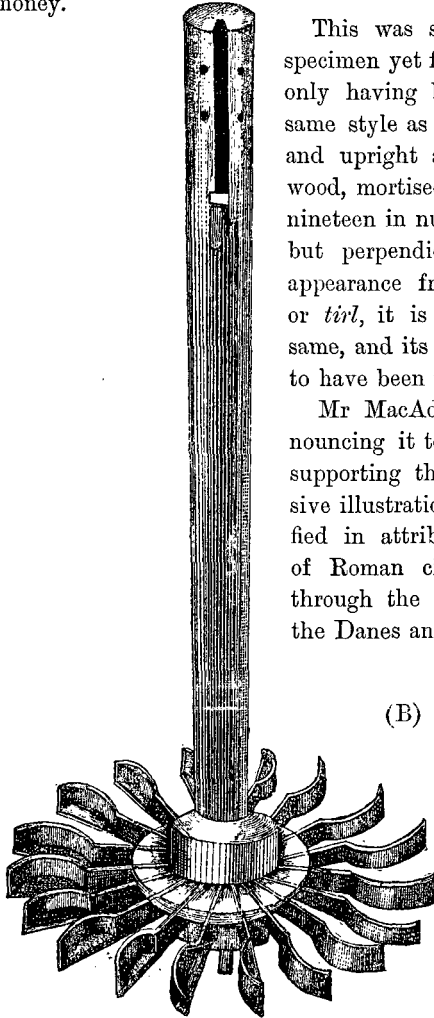


Fig. 13. Ancient Irish Mill-Wheel.

This was stated to be the most perfect specimen yet found in Ireland, a few portions only having been restored in precisely the same style as the existing parts. The nave and upright axle were of a solid piece of wood, mortised with float boards or buckets, nineteen in number, curved, and not slanting, but perpendicular. Somewhat different in appearance from the Shetland water-wheel or *tirl*, it is nevertheless substantially the same, and its mode of working would appear to have been identical.

Mr MacAdam had no difficulty in pronouncing it to be the wheel of a water mill, supporting that view with absolutely conclusive illustrations. He thought himself justified in attributing it not to the influence of Roman civilisation, but to the Gothic, through the conquests and colonisation by the Danes and Norwegians in Ireland.

(B) EUROPEAN COUNTRIES.

Passing from the United Kingdom, we find that horizontal mills were little more than a century ago very common on the Continent.¹ In the southern provinces of France, where the horizontal

¹ *Ferguson's Lectures on Mechanics*, 1764, Brewster's edition, 1806, vol. ii. p. 179.

wheel was very generally employed, the float-boards are said to have been of a curvilinear form, so as to be concave towards the stream; these flat boards when concave, according to the Chevalier de Borda, producing a double effect. It would seem from the drawing given by Ferguson, that the machinery, which was apparently of iron, was vastly more complicated and costly than in the case of the Shetland mill; though possibly, in remote districts, a more primitive form may have been in use. But in Norway, and in the Scandinavian isles of Feroe lying near to Shetland, and peopled by the same race, the old horizontal mill was, and in many places still is, in active operation.

Norway.—The peasant mills of Norway, and the circumstances connected with their erection and ownership, seem to be, with only slight variation, the counterpart of those of Shetland.

Laing, writing in 1836, states that “in Norway there is no astriction to mills: every man has Odel’s right, or, as I understand the term, holds them without service, suit, feu, astriction, or other burthen. Every man may build a mill who chooses to do so. In the glens about Laurgaard, every little farm has its own little mill.”¹ The mill is then described. The details are too minute and the paragraph too lengthy to be quoted, but any one desiring to pursue the inquiry further may refer to the original.²

The Norwegian mill was also noted and described by Robert Chambers, in his *Tracings in the North of Europe*. At Kingsvold he inspected “the corn-mill of the establishment; a small timber house striding over a precipitous mountain streamlet. It contains space for little more than the mill-stones, the upper of which moves on the lower by virtue of a vertical beam descending into a socket in the bed of the stream. The lower part of this beam is furnished with horizontal pans, against which, on one side or the other, the water pours down a sloping trough, so as to wheel it round. It is the very first mechanical effort after the use of the hand-mill of primitive times.”³

In my own too rapid travelling through Norway some years ago, the

¹ *Journal of a Residence in Norway*, by Samuel Laing, Esq., London, 1836, p. 46.

² *Ibid.*, pp. 50, 51.

³ *Edinburgh Magazine*, No. 311, December 15, 1849.

native mill did not attract my special notice. It is confined for most part to remote districts, and is little, if at all, known in the neighbourhood of the larger towns. Herr Hans Blydt, of the city of Bergen, was, however, good enough to procure for me the model in miniature of the horizontal wheel now in use, shown in the following woodcut (fig. 14).

The correspondence between this and the Shetland *tirl* is obvious. The bevelled groove or *slot* on the side at the upper end is similar to

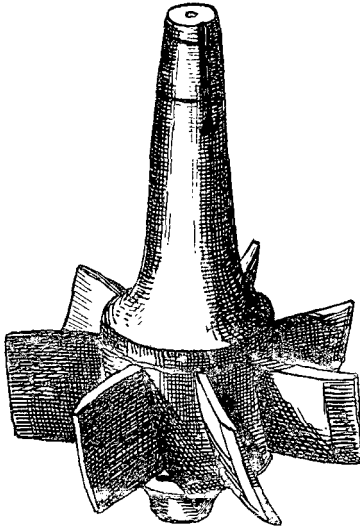


Fig. 14. Norwegian Mill-Wheel
(from a Model).

that in the ancient Irish example (fig. 13). In that case, its object, after some discussion, was supposed to be for raising or lowering the mill-stone.¹ It appears really to be in connection with fixing the axle into the upper mill-stone in a different way from the Shetland method. The float-boards are seven in number, fixed diagonally, and slightly concave.

The close similarity, not to say practical identity, of the primitive mills of Norway and of Shetland, has been further confirmed to me by Mr James M. Goudie of Lerwick, after a recent personal inspection of a number of mills in the Hardanger and Romsdal districts of Norway. The Norwegian names

of a number of the parts have already been given on page 279.

Feroe Isles.—The native mill is not alluded to in the quaint and interesting account of Feroe, *Færoæ et Færoa Reserata*, by the Rev. Lucas Jacobsen Debes (translation published in London 1676), probably because at that time there may have been very few of them, or because they may not have been considered to possess any unusual interest. It is, however, fully explained in the *Description of the Feroe Islands*, by

¹ *Ulster Journal of Archaeology*, vol. iv. p. 6.

the Rev. G. Landt (translation, London 1810) :—" Water mills are become much more common than formerly, so that at present there are in all the islands about twenty of them. The construction of a water mill in Feroe is exceedingly simple. The building for the most part consists merely of wood, the roof being supported by four posts or pillars ; but to save timber, these pillars are sometimes built of stone mixed with mud. It is entirely open below, so that the water can have a free course through it. On the ground is placed a loose beam, having in the middle a piece of iron with a smooth hole in it, which, however, does not pass through the beam. The hole is made to receive the gudgeon of a perpendicular axle, which proceeds up to the mill-stone, and this axle supplies the place of a crown wheel and spindle. To the upper end of the axle is fixed a round rod of iron, which passes through the lower stone, and which supports the iron cross that bears the upper mill-stone. At the lower end of the axle there are eight leaves or boards mortised into it, about 18 inches in length, a foot in breadth, and from 1 to $1\frac{1}{4}$ inch in thickness. These leaves, which perform the part of a water-wheel, do not stand exactly in a perpendicular, but a somewhat oblique direction, so as to turn their flat sides a little up towards the water, which falls upon them ; and the spout, which must give the water a sudden fall, is placed with its lower end close to these leaves. From one end of the beam lying on the ground, which supports the axle and the upper mill-stone, a piece of wood rises in a perpendicular direction towards the mill-work, where it rests on wedges ; and by pushing in or drawing out these wedges, the upper stone can be raised up or lowered at pleasure. The mill-stone makes 100 revolutions in a minute ; but as the stones in general are small, and have no furrows in them, they grind slowly, and are not well calculated for the preparation of grits or barley. The erection of a mill of this kind costs about 50 dollars" (p. 293).

I have been careful to transcribe the whole passage, as it might be held to be perhaps a fairly complete description of the Shetland mill, instead of being, as it is, of that of Feroe.

Iceland.—In Iceland there is little or no native grain. Had it been otherwise, we should doubtless have found the primitive mill in

operation there also, and occupying a place in the native literature. The *Grotta Songr*, or mill song, must be understood as referring to the hand-mill or quern. It is one of the most ancient of the Norse lays, part of the Edda circle. Fenja and Menja, the spæwives who were set to work the mill in Frodi's palace, sung—*Leggiom lúdra, lettom steinom* (Let us fit the bin [Shetland, *lúdr* or meal-house], let us lighten the stones). As the catastrophe approaches—

Molo meyjar, megins kostódo ;
 Vóro ungar i iætun-modi
 Stukko stórar stedr frá lúdri
 Iarnar fiardar
 Skulfo skap-tré, skautz lúdr ofan :
 Hraut in hœfgi hallr sundr i tvau.

(The maids ground on, putting forth all their strength; the young maids were in giant fury. The high props flew off the bin. The shaft-tree shivered, the bin shot down, the massy mill-stone rent in twain).—*Corpus Poeticum Boreale*, vol. i. pp. 184-188.

Sweden.—I am assured by Major Alf Björkman, director of the *Tekniske Skole*, or School of Arts, in Stockholm, that the primitive mill, with horizontal wheel, is quite well known in Sweden, though no accurate description of it, or illustrative drawings, are available.

Denmark.—Professor Stephens of Copenhagen, after consulting reliable authorities, informs me that the horizontal mill in question is wholly unknown in Denmark.

THE SHETLAND MILL—WHENCE DERIVED?

The close resemblance of the Shetland mill to that of Norway and the Feroe Isles, and the continuance of these primitive mills in remote districts of Norway, and also of Sweden, to the present day, would give countenance to the conjecture that it was derived from Scandinavia, as was suggested two centuries ago in the Irish manuscript of Montgomery, 1698, previously quoted. Certainly the survival of these mills to the present generation in the north of Scotland, and to comparatively recent times in Ireland and the Isle of Man, all familiar districts to the roving

Norseman, strengthens rather than impairs that theory. The comparison given on p. 279 *ante* of the names of different parts of the mill, some of which are almost identical in Shetland and in Norway, is also still further corroborative. But though all this cannot prove that the horizontal mill of Shetland is necessarily of Norwegian origin, it establishes this much, that if not introduced into Shetland direct from Norway, it was in existence in both countries at an early period when one language was common to both. The mill in the one case must therefore either have been derived from the other, or in both cases it must have been derived from a common ancestry. The mill, as we now have it in Shetland, may therefore not only date from the days of Harald of the Fairhair (ninth century), as Hibbert casually suggested, but its essential principle, the horizontal water-wheel—the first effort in mechanics beyond the hand-mill—may have been reached, and the names been conferred at a much earlier period in the history of the Teutonic peoples. These original names (like the mill structures and their simple machinery) have almost everywhere disappeared, and we can now only find a few fugitive relics of them in out-of-the-way corners in Shetland and in Norway, many of them having doubtless undergone more or less mutation in form, or been altogether superseded by new names.

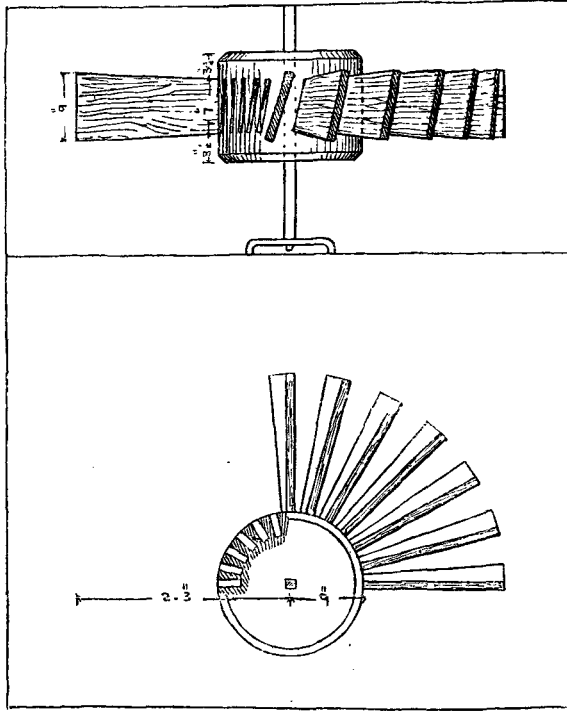
But the probability is that the horizontal mill may derive its origin from a point still more remote than the historic period of the Teutons in Europe, and from sources more near to the primal seats of the Indo-European race. Niebuhr states that he did not see either water mills or wind mills in all Arabia,¹ but I am informed that the horizontal mill is common in Persia at the present day. Mr J. Romilly Allen, Rhind Lecturer in Archæology, tells me that he has seen such mills at work in that country, and the following drawing executed by him shows the resemblance to the working apparatus of the ordinary Shetland mill (figs. 15, 16).

The Praying Machine of Thibet is, I believe, of similar construction.

Horizontal mills are, or about the middle of last century were, common also in Syria:—"Those which I saw on Mount Lebanon and

¹ *Beschreibung von Arabien*, p. 217, quoted by Beckmann.

Mount Carmel have a great resemblance to those which are found in many parts of Italy. They are exceedingly simple, and cost very little. The mill-stone and the wheel are fastened to the same axis. The wheel, if it can be so called, consists of eight hollow boards, shaped like a



Figs. 15, 16. Horizontal Mill-Wheel—Persia.

shovel, placed across the axis. When the water falls with violence upon these boards it turns them round and puts in motion the mill-stone over which the corn is poured" (Darvieux, *Merkwürdige nachrichten von seinen Reisen*, part iii., Copenhagen and Leipsic, 1754, Beckmann).

Darvieux's references here are sufficient evidences of the existence,

in his day, of the horizontal mill in Syria and in Italy. I have not observed it in the latter country, and have not had access to any corroborating authority of the present day.¹ It is clear, from accounts given by Vitruvius and others, that water mills were in use in the time of Augustus, but it is not certain that these were of the kind in question, working horizontally. The horizontal principle in another form was, however, well known to the Roman people in the first century, as is attested by the singular hand-mills which stand in the disinterred baker's shop in Pompeii. The development of water-mills from classical times is exhaustively discussed by Professor Beckmann of Göttingen in his *History of Inventions*, published in English in 1797. But it is doubtful whether this laborious investigator had any clear idea of the primitive form of horizontal mill, almost the sole survival of which we have seen at work at the present day in Shetland. And though, in Europe, it is in Shetland, and almost in Shetland only, that we find it in active operation, it has, I think, been shown conclusively that it has not in the past been peculiar to Shetland, but that it has been known from an early period, and over a widespread area, not only in Europe, but in Asia as well; and that it may indeed be regarded as a significant illustration of the tendency to a uniform evolution in the phenomena of civilisation, under given conditions.

I cannot conclude this paper without expressing my indebtedness to Mr John Romilly Allen, C.E., Rhind Lecturer; Mr James M. Goudie of Montfield, Lerwick; Mr D. William Kemp, Vice-President of the Royal Scottish Society of Arts; and Mr J. Russell Walker, F.S.A. Scot., for invaluable aid in its preparation.

¹ A writer in the *Scotsman*, of date 24th August of the present year, in giving an account of a visit to the old Roman Quarries of Carrara, remarks:—"By-and-bye our road struck the level of the river, and we inspected one or two primitive meal mills. They had horizontal wheels, such as we have seen in use in some parts of Shetland."