A Horizontal Mill at Knocknagranshy, Co. Limerick

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The corn mill in common use in Ireland, Britain and Central Europe till recent times was operated by a large waterwheel which revolved vertically on a horizontal axle, the motion of the wheel being transferred to the upper millstone by means of gearwheels. Another and simpler type of mill, with a wheel which revolved horizontally, was to be found in the countries bordering the Eastern Mediterranean and in Eastern Europe. This type also extended along the Atlantic seaboard, from Portugal through North-West Spain, Western France and Western Scotland to Scandinavia. Mills were in use in Ireland at least as early as the seventh century A.D. and, so far as is known, they belonged exclusively to the horizontal type. Those with vertical wheels were, in all probability, introduced in post-Norman times but the horizontal mill remained in use in many parts of the country and survived in some numbers in Connacht until well into the nineteenth century.

The horizontal mill consisted of a small two-storeyed wooden building, usually erected on a race or channel into which water was diverted from a neighbouring stream. To ensure a steady supply, the water was impounded in a pond immediately above the mill, from where it was led to the wheel through a large wooden trough or chute hollowed out of a single length of timber. The lower storey of the building was open at each end, the water entering at one and flowing out at the other. The grinding was carried out in the upper storey where the millstones were set up. The mechanism consisted of a long vertical wooden shaft, terminating below in a top-shaped nave or hub into which were mortised a number of scoop-like wooden paddles which radiated from it like the spokes of a wheel. The pointed lower end of the nave rested in a hollow seating of stone or wood in which it revolved. An iron spindle attached to the upper end of the shaft passed through an opening in the floor of the upper storey and through a hole in the lower millstone. The top of the spindle was fastened to an iron bridge or rynd let into the lower surface of the upper stone, so that when the spindle turned it carried the stone around with it. The jet of water from the chute was directed against one side of the wheel and impinged on the scoops of the paddles causing it to revolve. All the remains of Irish wheels that have been discovered show that they were designed to rotate in a clockwise direction. As the wheel, shaft, spindle and upper stone formed, in effect, a single unit, no intermediate gearing was required and one revolution of the wheel produced a corresponding revolution of the upper stone. The operation of the mill was controlled by admitting or cutting off the supply of water to the chute by means of a sluice gate.¹

The existence of the Knocknagranshy horizontal mill was first reported to the National Museum by the late Mr. David Cantwell of Croom, Co. Limerick, in a letter dated December 28, 1954. The writer visited the site on May 20, 1955, and permission to excavate it was readily given by the owner, Mr. Geoffrey Lane of Knocknagranshy, who subsequently donated the chute and its supporting beam to the National Museum.8

The site lay in a boggy field which sloped gently westwards to a boggy rush-grown bottom. It consisted of a low, roughly pear-shaped mound with an irregularly hummocked surface, which measured about 15.3 m. east-west and 6.35 m. in maximum width north-south. Lying on the long axis of the mound at its broadest part was an oak chute, wider at one end than at the other. The narrow end, which lay to the west, rested on a large oak beam set on edge which ran north-south under it. The chute had been discovered in 1942 by the landowner, Mr. Lane, in the course of some minor clearance work. It lay close to the surface and, beyond clearing the soil from it, he had left it undisturbed. Despite exposure to the weather for twelve years, it was in a remarkable state of preservation and relatively undamaged (Pl. I). There was no visible trace of any water channel leading into the site or any sign of an exit channel. The only source of water in the vicinity is a holy well called Toberlaghteen which lies about 62 m. north-east of the site and at a considerably higher level. The original well, which is now dry, was surmounted by a small stone-built cupola with a slab above the doorway bearing the inscription: 'This was erected by James Keating in ye year of our Lord 1791 that lived in Grangehill Pray for him.'8 Grangehill is, of course, a translation of Knocknagranshy (Cnoc na Gráinsigh, 'the hill of the grange or barn'). The spring, which is overshadowed by a large ash tree, breaks out just beside the cupola and forms a large pool about 3 m. in diameter. The site is situated about two miles in a straight line north-east of Croom and its position will be found on Limerick O.S. 6-inch sheet 22, at a point 18 cm. from the west margin and 6.5 cm. from the south margin.

In order to ascertain the stratigraphy of the site, a cutting 8 m. long, 1 m. wide and 1 m. deep was made north-south across its widest part, its west edge being almost in line with the beam supporting the chute (Fig. 1). On either side this cutting extended into the peat which surrounded the site on all sides and sectioned two parallel banks, c. 4 m. part, which ran longitudinally east-west across the middle of the site. These banks were found to consist of yellow clay which, to judge by its extreme hardness, must have been intensively puddled before being placed in position. Both banks had been erected directly on the underlying peat (Fig. 1: section). The one to the south, which was the better preserved for most of its length, rose in a sharp crest to a height of 50 cm. above the peat; its fellow to the north appeared to have suffered considerable disturbance and was lower and less well defined. Outside the north bank and separated from it by a steep narrow ridge of peat, the top of which reached the existing

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8 The excavation was carried out from August 16–20, 1955, by the writer who is much indebted to Mr. Kevin Danaher, Irish Folklore Commission; Mr. John Shine, Granagh, Kilmallock; and Mr. James Cantwell, Croom; who voluntarily rendered indispensable assistance in the work. He also wishes to acknowledge the help which he received in keeping the excavation records from Miss A. R. Birmingham, Assistant Secretary, Royal Society of Antiquaries of Ireland, Mr. Kevin Danaher, and his wife. All the local arrangements were made by the late Mr. David Cantwell, from whom and from whose family the excavation party received the utmost kindness and hospitality.

8 JRSAT, 85 (1956), 214.
ground surface, there was a spread of yellow clay lying to a considerable depth in a hollow 140 cm. wide in the peat, but it could not be determined whether this was an original feature or whether it represented part of the north bank which had been used to fill in a hollow resulting from turf-cutting. The abrupt slope of the ridge of peat suggests that the latter explanation may be the correct one. An area 4 m. long and 2 m. wide immediately to the east of the wide end of the chute was then excavated, the bank of yellow clay on the south side being sectioned longitudinally in the process.

The excavation revealed that the mill had been erected on the peat which underlay the whole site. In the area east of the beam supporting the chute, a hollow, 4 m. long, 2.5 m. wide and 60 cm. deep at its lowest point, had been dug in the peat. This was filled with yellow clay mixed with small rounded stones, the clay being also piled in two parallel banks along the north and south sides of the hollow. The chute lay on this clay which extended to a depth of 30 cm. below it. At a distance of 38 cm. east of the wide end of the chute traces of a stone facing came to light at the foot of the south bank (Fig. 1). It survived to a height of 40 cm. and curved slightly to the south away from the east-west line of the rest of the bank. This facing incorporated one large stone 68 cm. long, 29 cm. high and 25 cm. thick with a flat outer face, the remainder of the stones being of smaller size. The facing was traced for a distance of 2 m. to a point where the bank ceased abruptly, having, apparently, been cut through at some time. A scatter of stones at this point can best be interpreted as the remains of the facing which had been disrupted when the bank was cut. There was no evidence for a similar facing on the north bank but this, as has been stated previously, had suffered considerable disturbance.

The mass of yellow clay which lay between the clay banks immediately to the east of the beam supporting the chute and on which the chute itself rested, formed the head of the millpond where the water was admitted into the chute. If, as seems most probable, the north bank was originally faced with stone like its southern counterpart, the space between them would have served to impound a head of water for delivery down the chute to the wheel. The outward curve of the stone facing of the south bank recalls the timber-faced triangular heads of the ponds of the horizontal mills which were discovered at Knockrour, Co. Cork, and Morett, Co. Laois. There was, of course, no means of ascertaining how much higher the mass of clay on which the chute rested or the banks themselves may originally have been.

As there were no visible traces of the banks which must have enclosed the rest of the pond and no surface indication of the water channel which must have fed it, a cutting 1 m. wide and 2 m. long and running north-south was made at a distance of 10.6 m. from the east end of the chute (not shown on Fig. 1). This excavation was carried to a depth of 115 cm. and the following stratigraphy, reading from the surface downwards, was revealed: humus, 30 cm.; yellowish-grey sticky clay with some stones, 50 cm.; light grey and extremely sticky clay, full of small particles of stone, 35 cm. Although this stratification was, apparently, completely undisturbed and although no indication of banks or channel came to light, the total absence of peat in the excavated area did show that, in the short distance of 10 m., there was an exceedingly abrupt transition from this peatless zone to the very considerable depth of peat

\[4 \text{ JCHAS, 31 (1928), 97-98.} \]
\[5 \text{ JRSAI, 88 (1898), 16-17.} \]
underlying the mill-site which, as later probing showed, was in excess of 2 m. This is, very probably, to be attributed to the cutting over centuries for fuel, of the peat which in all likelihood formerly covered a much wider area of the sloping ground to the east of the site. Although the mill-site now stands elevated over the surrounding land, this appears to be due to the lowering of the level of the latter by turf-cutting and by the shrinkage of the remaining peat as the result of drainage. The existing relationship in level between the mill and the surrounding bog must have stood in reverse at the time when it was in operation so that the subsequent obliteration of the pond and its feed channel is not at all surprising.

The area, the investigation of which has been described above, lay to the east of the beam supporting the chute and comprised about half of the site. The other half, lying to the west of the beam, was the place where the mill building proper would have stood with the wheelhouse below it. Before excavation, it appeared as a roughly rectangular platform, bounded on the north and south sides by low but still perceptible continuations of the two banks which bordered the east half of the site. These were traceable for a distance of about 5 m. west of the beam, and the irregular surface of the platform between them reached almost to the level of the top of it. When the area had been excavated, it was found that the inner faces of both banks had been lined with an irregular skin of large rounded stones, some of which were 70 cm. long, 50 cm. wide and 20 cm. thick (Fig. 1). The facings of the two banks, which survived to a height of about 100 cm., ran parallel to each other, at about 170 cm. apart, for a distance of 3.6 m. from the beam supporting the chute, which lay at right-angles to them, one abutting on either end of it. The space between them was filled to a depth of about 50 cm. with dark friable soil, evidently containing a large admixture of peat, which had a small number of moderately sized stones and animal bones, chiefly of ox, mingled with it at all levels. This soil also filled the interstices between the stones facing the banks. Below this fill was a layer of leached grey sticky soil about 13 cm. thick which probably represented the grass sod which had formed on the surface of the wheelhouse floor in the years following the complete ruination of the abandoned mill building. This was succeeded by a layer of fine white sand, without stones, about 14 cm. thick. Two further layers underlay the sand; the upper, 13 cm. thick, consisting of sticky yellow clay with large angular stones up to 30 cm. long embedded in it; the lower, 22 cm. thick, consisting of coarse sand with large angular stones. The latter layer rested on peat of an unknown but very considerable depth. Two facts were noted in the course of excavation which seem to have a bearing on the origin of one layer in this stratification, that of the fine white sand. The first is that the layers of yellow clay and coarse sand did not exist in the area immediately west of the beam which, as will be described later, had been floored with overlapping boards. These boards rested on the layer of fine sand which, in this area of the wheelhouse floor, lay directly on the underlying peat. Since, as will presently appear, the laying down of the board floor was an essential preliminary to the setting up of the millwheel and since the sand underlay it, the sand cannot have been derived from the layer of yellow clay by the wash of water running off the wheel. Since the chute cannot have been in use before the wheel was placed in position which cannot, in turn, have been affected before the floor boards had been laid down, the sand cannot be interpreted as inwash from the pond via the chute. It is, in any event, extremely unlikely that the intake end of the chute would have been set so near the bottom of the pond as to allow the sand to be washed in. Moreover, no similar deposit of sand was observed
during the excavation of the head of the pond itself. The second fact which was noted was that the layer of fine sand extended under the bottom stones of the facing of the long sides of the wheelhouse, showing that the layer had been laid down before these facings had been built. All these considerations indicate that the layer of fine sand was deliberately spread over the floor of the wheelhouse as part of the technique of constructing it.

The excavation showed that the wheelhouse and its superstructure housing the millstones had been erected on the peat. The first step may have been the building of the two parallel banks of yellow clay and the next the spreading on the area between them of a layer of coarse sand, followed by one of yellow clay mixed with angular stones, upon which was distributed a coating of fine white sand. Alternatively, a layer of coarse gravel, followed by a layer of yellow clay, may have been spread over the whole area to be occupied by the banks and floor, the former being then built on this foundation and the space between them coated with the fine white sand. Whichever procedure was adopted, the next step was the facing of the inner sides of the banks with a skin of large stones.

It has been stated previously that the layers of coarse sand and yellow clay were absent from that area of the floor immediately to the west of the beam supporting the chute and that here the fine sand lay directly on the peat. In this area were found three boards, all very fragmentary, all somewhat distorted by the weight of the fill which had overlain them but all still in their original positions (Fig. 1). They ran parallel to the beam, the nearest to it being 34 cm. distant from it. They overlapped each other towards the west, that is, in the direction of the water flowing away from the wheel and out of the wheelhouse. What remained were only short fragments of the original boards, but the ends of two survived intact on the north side where they were butted against the base of the stone lining of the bank. The maximum dimensions of the fragment farthest from the beam were: length, 55 cm., width, 18 cm., thickness, 3 cm. The corresponding measurements of the second board were 92, 11 and 5 cms., and those of the third, 78, 10 and 6 cms. Owing to the overlapping, the width across the three boards in situ was only 34 cm. In section, they were very squat triangles and they were laid with the flat sides uppermost. It is evident that these boards were the remains of a wooden floor which formerly extended across the full width of this section of the wheelhouse. Wooden floors were a feature of the wheelhouses of the majority of the sites of horizontal mills which have been investigated, being just as characteristic of those built on firm ground as of those erected in boggy situations. In a number of cases, the wooden flooring was confined to the area where the water entered from the chute. The flooring was essential to provide a stable seating for the wheel, since, in addition to the weight of the shaft and wheel, this seating had also to sustain the weight of the upper millstone. The seating, whether of stone or wood, did not rest directly on the floorboards but on a beam or plank, one end of which could be raised or lowered by means of a lever, thus enabling the shaft to be raised or lowered when the clearance between the millstones had to be adjusted. If this plank were placed on the ground surface of the wheelhouse floor, it would be difficult to maintain it in a stable position on account of the inevitable erosion of the soil below it by the wash of water from the wheel. The wooden floor was, therefore, an integral part of the design of the mill and a prerequisite for setting up the wheel satisfactorily. At the Knocknagranshy site the layers of coarse sand and yellow clay and stones were omitted in the area to be covered by the floorboards, since it was
easier to lay the boards level on the surface of the peat, the softness of which was compensated for by the fact that the boards spread the weight of the mechanism over a wide area thus obviating the danger of subsidence. The layer of fine sand which had been spread on the peat prior to the laying of the boards may have been intended to facilitate adjusting them in position when they were being laid, as it would have prevented the wet peat from sticking to their undersurfaces. A floor of similar overlapping boards was a feature of the head of the pond at the mill which was discovered at Morett, Co. Laois.6

The only other timber which came to light was a board which ran transversely across the west end of the wheelhouse at a distance of 291 cm. from the beam supporting the chute. It lay at a depth of 100 cm. below the ground surface and under the layer of yellow clay. It was exceedingly soft and rotten and much penetrated by plant roots. At the north side it butted against one of the large stones that lined the bank; its south end ran below the stone facing on that side and into the clay of the bank itself. It was convex on the upper face and flat below, both surfaces being tolerably true, and it was 18 cm. wide and 7 cm. in maximum thickness. In view of its slender proportions and of the position it occupied, it could have had no structural function but it may have played some part in the laying out of the site or in establishing its different levels. Its position coincided with the west end of the wheelhouse.

No evidence was found about the nature of the superstructure of the mill. There was no accumulation of stone on the site to suggest that it had been built of that material. It is possible that the banks of yellow clay were the remains of two clay side walls but in view of the fact that oak trees of large size were, evidently, available in the locality at the time when it was built to provide the chute and its massive supporting beam, it seems more probable that the building was completed in timber.

The Chute
(Fig. 2, Pl. 1)

This, as has been said, had been uncovered fourteen years prior to the excavation of the site. Apart from the fact that it had undergone a certain amount of shrinkage, it was in excellent preservation and had suffered only minor damage. It lay approximately in its original position but the fore end rested on the upper edge of the supporting beam, having, at some time, been lifted out of the recess made to receive it. It was approximately rectangular in section and had been hollowed out of a single piece of oak. It tapered from the open rear end to the fore end which had been left unhollowed for a distance of 28 cm. This solid end was pierced by a central cylindrical hole, 26 cm. in diameter, which ran horizontally through it on the same level as the interior floor of the chute. The total length of the chute was 208 cm. The external width at one end was 70 cm. and 36 cm. at the other; the corresponding internal widths being 57 cm. and 15 cm. At the wide end the external height was 39 cm. and the internal 29 cm.; at the narrow end these measurements decreased to 35 cm. and 24 cm. respectively. There was a considerable variation in the relative positions of the bottom and sides, the latter splaying outwards at the wide end and sloping inwards from the midway point of the length to the narrow end. This irregularity must, in part at least, be attributed to warping following exposure to the weather.

6 JRSAI, 83 (1953), 16.
Fig. 2. Chute: plan, sections (below) and side-elevations
The front face of the fore end was cracked from the effects of shrinkage. One large split, which ran almost vertically from the top of the perforation to the upper edge, extended right through the entire length of the solid portion. There were, in addition, smaller radial cracks on the lower part of the face below the perforation. The front face was not at right angles to the plane of the bottom of the chute but sloped backwards to make an angle of about 80 degrees with it. A sloping face was also a characteristic of chutes with solid perforated ends which were found at Masanaglass and Knocknour, Co. Cork; Newtown, Co. Tipperary; Ballydowane West and Coolnanav, Co. Waterford; Kilkenny Castle and Ballygeardra, Co. Kilkenny; and Toberaquill and Clonickilvint, Co. Westmeath. On the interior surface of the chute, a horizontal ledge, about 5 cm. wide, ran along the full length of each side and continued around the inner face of the solid end, where its width increased to about 7 cm. and where it was about 5 cm. higher than its level on the sides. Owing to decay or damage, the north side of the chute did not survive to its full height but on the south side, which was better preserved, the ledge ran at a depth of about 7 cm. below the upper edge. This ledge was, obviously, intended as a seating for a lid. Six of the chutes recorded from the sites of horizontal mills, at Inchydoney and Knocknour, Co. Cork; Newtown, Co. Tipperary; Ballydowane West, Co. Waterford; Kilmagar, Co. Kilkenny; and Toberaquill, Co. Westmeath, were provided with wooden lids, and one at Masanaglass, Co. Cork, was lidded with a series of stone slabs resting on rebates in the sides. A second chute found at Newtown, Co. Tipperary, the one from Clonickilvint, Co. Westmeath, and one at Great Island, Co. Wexford, also had the sides rebated to take lids, while in the one from Coolnanav, Co. Waterford, the upper edges of the sides appear to have chamfered inner faces on which a lid correspondingly chamfered may have fitted. Moreover, all those chutes which had lids or which were designed to take one, had solid narrow ends like the Knocknagranshy example and all, with the doubtful exception of that from Kilmagar, also resembled it in having a similar sloping front face.

In the south side of the chute, at a distance of 8 cm. from the narrow end, there was an oval opening, 8 cm. long and 6 cm. wide, with its longer axis horizontal, which pierced the wall of the chute between its upper edge and the interior ledge, at a depth of 4 cm. below the former. Portion of the wood between the hole and the upper edge

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7 *JCHAS*, 61 (1956), 26-27.
8 *JCHAS*, 31 (1926), plate facing p. 102.
11 Information from Professor M. J. O’Kelly, University College, Cork, 15.1.1970.
15 Sketch in manuscript notes by Rev. W. Falkiner, Killucan, Co. Westmeath, in the possession of Mrs. Ruth Bayly-Vandeleur, Wardenstown, Co. Westmeath, to whom the writer is indebted for this information.
16 *RSat*, 1 (1849-51), 159.
17 *JCHAS*, 31 (1928), 66.
18 *RSat*, 1 (1849-51), 158.
19 *JCHAS*, 31 (1928), 26.
had been broken away. It is possible that there was a corresponding opening in the north side of the chute, the upper portion of which was missing at this point. If there were, the holes may have served to hold a transverse bar of wood to keep the lid firmly in position. Another feature of the chute was a number of rectangular hollows in its exterior surface. One of these, measuring 9 cm. long, 4.5 cm. wide and 5 cm. deep, was situated on the north side at a distance of 30 cm. from the wider end and 10 cm. below the existing upper edge. There probably was, originally, a similar hollow in a similar position on the south side also. On either side of the narrower end of the chute and at a depth of 9 cm. below the upper edge, there was a similar rectangular hollow, 6 cm. long, 4 cm. wide and 4 cm. deep. The long sides of these hollows were parallel to the top and bottom lines of the chute and they lay at the point where the solid portion of the fore end commenced. Similar hollows, but oval rather than rectangular, occupied approximately similar positions in the two chutes found at Newtown, Co. Tipperary. No function can be suggested for the hollows near the wider end of the Knocknagranshy chute, but it is conceivable that the other two were intended to play some part in holding the fore end of the chute securely in the recess in its supporting beam. The leading lower edge of the fore end of the Mashanaglass chute was rebated to engage with the edge of a stone in the wheelhouse wall to obviate all risk of movement, a feature also observed in the two chutes discovered at Newtown, Co. Tipperary.

Supporting Beam
(Fig. 3)

This massive oak beam stood on edge across the east end of the wheelhouse and supported the narrower end of the chute which lay at right angles to it. It was 216 cm. long, 46 cm. wide and about 18 cm. thick. At a distance of 65 cm. from the south end, a recess, 48 cm. long and 25 cm. deep, had been cut into the upper edge to house the fore end of the chute. All the faces of this recess were true and the lower one sloped downwards slightly from east to west to conform with the bottom of the chute which, when in position, inclined downwards in the same direction. As stated above, the fore end of the chute had been lifted out of this recess and when it was replaced, it was found to project some 40 cm. beyond the west face of the beam. Since, however,

Fig. 3. Beam supporting chute: plan, section and elevation showing west face
there was no means of knowing the amount of displacement from its original position which the chute had suffered in either the vertical or the horizontal plane, it is impossible to say to what extent it projected when the mill was operational, or whether it was set flush with the face of the beam. The asymmetrical location of the recess, nearer to the south than to the north end of the beam, indicates that, as was normal in Irish mills of this type, the water impinged on the left hand side of the wheel to revolve it and the millstone in a clockwise direction. At a distance of 4.5 cm. from the north end of the beam there was what appeared to be a second but smaller recess, 27 cm. long and 9 cm. deep, cut into the upper edge. Its faces were irregular and it might, at first sight, be dismissed as the result of decay or damage were it not for the fact that a similar small recess in perfect preservation was present in the supporting beam of a mill discovered at Castleinich, Co. Kilkenny.\textsuperscript{21} Nothing has yet been discovered which would explain the function of this small additional recess but it may be pertinent to note that a large rectangular mortice occupying the same position was present in the supporting beams of mills found at Ballykilleen, Co. Offaly,\textsuperscript{22} and Ballygormill South, Co. Laois.\textsuperscript{23} At the lower edge of the face of the beam next the wheelhouse, there were three irregular openings, one at the north end, the second 7 cm. from the same end and the third about 40 cm. from the south end. The first two of these holes lay close to the lower edge of the timber, the third about 6 cm. above it. They do not appear to have had any functional purpose and, as this was the least well preserved part of the beam, they may have been knot-holes enlarged by decay.

Although the site yielded none of the structural timbers which are characteristic of the majority of Irish horizontal mills, the chute and its supporting beam were quite typical, as was, too, the wooden flooring in the area of the wheelhouse adjacent to the chute. On the other hand, the erection of the mill on a foundation layer of clay and stones laid down on the underlying peat, with clay banks, similarly built on the peat, margining the head of the pond and the sides of the wheelhouse, is a method of construction that has not been recorded from any of the mill sites so far discovered.

\textsuperscript{21} Investigated by the writer on 28.5.1955. Publication forthcoming.
\textsuperscript{22} JRSAI, 86 (1956), 104.
Knocknagranshy, Co. Limerick: horizontal mill before excavation, with chute in position

(Photo: A. T. Lucas)