

Such conclusions are not unexpected. In 3-floored mills, the optimal location of the stones is the second floor, allowing the grain to be fed from the (dust) floor above and the meal to be collected on the (ground) floor below. The disadvantage of such a layout is that the grain may become damp through rain penetrating the cap, or soiled by grease etc flying off the gear wheels. The confinement imposed by a 3-floored structure is possibly why so few (5) occur in the sample of 68 analysed (i.e, 7%).

This disadvantage can easily be overcome in a 4-floored mill by inserting an empty dust-floor between cap and bins; the stones would thus be on the third floor, with the ground floor acting as the meal floor. The miller might, however, have seen grain storage on the topmost floor as less disadvantageous than a cluttered ground floor, preferring to keep the entrance floor clear for grain and meal movements to and from the mill. Such an arrangement would thus be (1) dust or bin floor, (2) meal floor, (3) stone floor, (4) ground floor. The stones thus remain on the second floor, as in a 3-floored mill. Either way, such a floor arrangement is constrained to some degree; a fact possibly recognised by the fact that only 15 mills (22%) in the sample have four floors.

Such disadvantages are overcome completely in a mill having five or more floors; the usual arrangement being (1) (empty) dust, (2) bins, (3) stones, (4) meal, (5+) empty subsequent floors as far as ground level.

Obviously there are cost and structural limitations to the construction of multi-floored mills. Five floors would seem to offer the best combination of maximum flexibility of floor arrangement and cheapness of construction. Not surprisingly the majority of mills (29) in our sample fall into this 5-floored category (43%); a further 16 (24%) have six floors, whilst only 3 (4%) have seven floors.

To summarise thus far, the "norm" would appear to be that 3-floored mills have stones on the second floor, 4-floored mills have them on either the second or third floors, whilst mills of five or more floors generally have them on the third floor.

Abnormal Stone-floor Arrangements

What of the "abnormal" stone-floor arrangements? The most significant deviations from the norm occur in mills having five or more floors, where in seven instances the stones are on the second floor, as in Fig 2. Several explanations suggest themselves; (1) they are regional aberrations, (2) they reflect some technical constraint, (3) they represent a constructional style pertaining to a certain time period.

That this is not a regional variant is confirmed by comparing their geographical distributions with their respective norms; all have similarly wide occurrence (cf. Appendix 1).

It might be argued that second floor stones simply reflect the need to minimise the distance between stones and brakewheel. In turn this could reflect the non-availability of long upright shafts able to transmit the power down to the third floor. If this were so, we might expect to find most second and third floor stones to be overdrift (in both cases minimising the length of the upright shaft).

Table 2, however, shows that this is not the case, so we can perhaps discount any technical of second floor stones.

Table 2

No. of Floors	Stone floor	Number of Overdrift	Number of Underdrift
5	2	0	5
5	3	10	12
6	2	0	2
6	3	5	1

A temporal analysis is possibly more revealing, as table 3 shows.

Table 3
Construction dates for various floor arrangements

No. of floors	Stone floor	Construction date						
5	2	c1800	c1800	c1800	1801	1879		
5	3	1775	1803	1804	1821	1831	1839	
		c1845	c1845	1851	1859	1866	1866	1876
6	2	1787	1821					
6	3	1794	c1820	1835				
7	3	1814	1819	1830				

Two points emerge from this table. Firstly, those mills with stones on the second floor date (with two exceptions) to around 1800 or earlier. An exception is Shipley, built in 1879. Interestingly, however, this mill incorporates machinery from an older mill, so its rebuilt layout may have been constrained by the older machinery. The other exception is Little Cressingham, built c.1821. Again, the layout may have been constrained to this particular arrangement, given the need to house the water-driven machinery lower down.

The second point is that the majority of mills having stones on their third floor date to well within the 1800's: out of 19 datable mills, only three are earlier than 1800.

Before continuing, it is perhaps wise to recall the configuration of 4-floored mills and their respective dates (table 4).

Table 4
Construction dates for 4-floored mills

No. of floors	Stone floor	Construction date						
4	2	1746	<1767	1784	?1790	1799	1817	1822
4	3	c1751	c1777	1784	1819	1826	c1858	c1900

Although the constraints of a 4-floored arrangement (outlined above) may well apply in particular instances, it is again interesting to note that most mills with second floor stones are, again, 18th century in date. As before, some mills with stones on the third floor are also datable to this period, but also extend well into the 19th century.

In short, these observations seem to imply that mills of five (possibly even four) or more floors, and having their stones on the second floor, reflect an earlier configuration than similarly floored mills having their stones on the third floor.

Of course, such an argument is based on a very small sample of mills, particularly those with stones on the second floor. However, there are several indicators which suggest this hypothesis is worthy of further investigation and should not be entirely discounted.

If we remember that the vast bulk of Irish windmills were erected before 1815, they can be regarded as fossilised records of basically 18th century cornmill construction. In all cases where the internal arrangement can be authenticated, the stones are on the second floor, irrespective of the number of floors and function (i.e., whether or oat or wheat milling). Moreover, in several instances (Stock and Stansted) the stones have been moved from the second down to the third floors at a later date.

Towards a Developmental Sequence

If this developmental sequence is valid, how can it be explained? Recalling that early post and tower mills had a one-step drive to one pair of overdrift stones sited just below the brakewheel (Fig 3a), it is evident that the insertion of another set of stones presents certain problems.

In the postmill, an additional drive could be taken off a tail wheel (Fig 3b). Alternatively, an underdrift spurwheel arrangement was sometimes adopted (Fig 3c). A tail wheel is of course impossible in a tower mill, as the cap must be allowed to rotate independantly of the machinery. The insertion of a spurwheel would thus have been necessary, which, if the postmill sequence had is adopted, would have been underdrift.

Interestingly, this seems borne out by the data (table 5).

Table 5
Drive to second floor stones

No. of floors	Stone floor	Number of overdrift	Number of underdrift
4	2	2	4
5	2	0	5
6	2	0	2

Roofing over the stones to exclude dirt and draughts, and to support the grain bins above, automatically results in the stones being on the second floor (Fig 3c).

That the stones subsequently shifted to the third floor may simply reflect the increasing bulk of grain processed by the mill, with the stones being shifted down to make way for bins and possibly grain cleaners on the second floor. Ashton Mill, Chapel Allerton, shows the earliest and latest phases of just such a developmental sequence.

In short, the increasing need to expand the mill's grinding capacity possibly led to the adoption of two pairs of second floor stones, a configuration that prevailed during much of the 18th century, if not earlier. During the 19th century, the advent of merchant milling and the need for increased storage capacity heralded the provision of a purpose-built bin floor below the dust floor, the stones then being shifted down to the third floor.

Subsequent Developments

Unfortunately neither time nor space permit the detailed analysis of instances where stones are on floors lower than the norm. Nevertheless, a brief perusal of the data may lend support to the arguments already elucidated.

Two cases - Hooper's horizontal mill, Battersea, and Smeaton's Chimney Mill, Newcastle, are unusual, to say the least. In the first instance, the stones are on the ground floor, and in the second, on the fifth floor down within a 6-floored mill. Such configurations do not seem to have been generally adopted.

In those cases where the stones are on the fourth floor, the additional space seems to have been occupied by additional bins and/or grain cleaners.

Obviously, if an underdrift arrangement were maintained, the upright shaft would have to extended by upwards of 3 m. A better solution would have been to reconfigure the drive as an overdrift arrangement; again, this seems borne out by the available data (table 6).

Table 6
Drive to fourth floor stones

No. of floors	Stone floor	Number with Overdrift	Number with Underdrift
5	4	2	2
6	4	5	1

Holgate, York, built c1790, is seemingly a particularly early example of this arrangement, which spans the 19th century, particularly the latter half (table 7).

Table 7
Construction dates for mills with stones on the fourth and fifth floors.

No. of floors	Stone floor	Construction date			
5	4	c1790	c1790	c1814	1890
6	4	c1807	1846	1864	1877 1892
6	5	c1815 (Chimney Mill excluded)			

We may wonder whether some of these earlier mills have in fact been modified from a third floor arrangement - a modification which as yet has gone undetected?

Conclusions

This paper is but a preliminary analysis of the spatial arrangement of windmill machinery. Whether the above arguments are valid is a matter for discussion at this conference. The author would, moreover, be glad of any corrections and additions to Appendix 1, and urges that writers of mill guides will think it worthwhile to state clearly the number of floors within mills and the disposition of machinery within.

Appendix 1.

No.	Location	County	No. of floors	Stone floor	Drive Date	Source
1	Ashton (1),	Som.	3	1	0 <1774	1
2	Chesterton	Warks	3	2	U 1663	2
3	North End, Burwell	Cambs	3?	2	U ?	3
4	North Leverton	Notts	3	2	U 1813	4
5	Hooper's Mill, Battersea	Surrey	3	3	0 1788	2
6	Barnham	Sussex	4	2	U ?1790	5
7	Mockett's, Polgate	Sussex	4	2	0 1817	4
8	Bembridge	I.o.W	4	2	U 1746	6
9	Stembridge, High Ham	Som.	4	2	U 1822	4
10	Ballybryan, Greyabbey	Down	4	2	0 <1767	7
11	Ballycopeland, Millisle	Down	4	2	U 1784	4
12	Climping	Sussex	4	2	? 1799	5
13	Thringstone	Leics.	4	3	U ?	8
14	Ashton (2),	Som.	4	3	U c1900	1
15	Thelnetham	Suffolk	4	3	U 1819	4
16	Swaffham Prior	Cambs	4	3	U c1858	3
17	Gibraltar, Great Bardfield	Essex	4	3	U c1751	9
18	Berkswell	Warks	4	3	U 1826	10
19	Whetley	Oxon	4	3	U 1784	11
20	Shiremark, Capel	Surrey	4	3	U c1777	12
21	King's, Shipley	Sussex	5	2	U 1879	5

No.	Location	County	No. of floors	Stone floor	Drive	Date	Source
22	Meopham	Kent	5	2	U	1801	4
23	Stock (1)	Essex	5	2	U	c1800	9
24	Ballyherly, Portaferry	Down	5	2	U	c1800	7
25	Balrath	Meath	5	2	U	c1800	7
26	Wilton	Wilts	5	3	U	1821	4
27	Stone Cross	Sussex	5	3	0	1876	5
28	Jack, Clayton	Sussex	5	3	U	1866	5
29	Burseldon	Hants	5	3	U	?	10
30	Stelling Minnis	Kent	5	3	U	1866	4
31	Bidborough	Kent	5	3	U	?	14
32	Edenbridge	Kent	5	3	0	?	14
33	Baker Street, Orsett	Essex	5	3	U	?	13
34	South Ockendon	Essex	5	3	U	?	13
35	Terling	Essex	5	3	0,U	?	13
36	Tiptree	Essex	5	3	U	1775	13
37	Stock (2)	Essex	5	3	0,U	?	13
38	Debenham	Suffolk	5	3	U	1839	15
39	Wickelwood	Norfolk	5	3	0	c1845	4
40	Billingsford	Norfolk	5	3	0	1859	4
41	Upminster	Essex	5	3	U	1803	4
42	Draper's Mill, Margate	Kent	5	3	0	c1845	4
43	Pakenham	Suffolk	5	3	0	1831	15
44	Thaxted	Essex	5	3	0	1804	13
45	Stanford	Kent	5	3	0	1851	14
46	Dalham	Suffolk	5	4	U	c1790	4
47	Wymondham	Norfolk	5	4	0	c1814	8
48	Holgate, York	Yorks	5	4	0	c1790	4
49	Downfield, Soham	Cambs	5	4	U	1890	4
50	Stansted (1)	Essex	6	2	U	1787	13
51	Little Cressingham	Norfolk	6	2	U	c1821	4
52	Long Clawson	Leics	6	3	0	?	8
53	Blackdown, Punnett's Town	Sussex	6	3	0	?	5
54	West Blatchington	Sussex	6	3	U	c1820	4
55	Denver	Norfolk	6	3	0	1835	4
56	Marsh Mill, Thornton	Lancs	6	33	0	1784	4
57	Stansted (2)	Essex	6	3	0	?	13
58	Keyingham	Yorks	6	4	0	?	16
59	Sneinton	Notts	6	4	0	c1807	4
60	Caston	Norfolk	6	4	U	1864	17
61	Heckington	Lincs	6	4	0	1892	4
62	Great Bircham	Norfolk	6	4	0	1846	4
63	Trader's Mill, Sibsey	Lincs	6	4	0	1877	2
64	Chimney Mill, Newcastle	Northumb.	6	5	0	1782	2
65	Wellington Mill, Barking	Essex	6	5	?	c1815	9
66	Cranbrook	Kent	7	3	0	1814	2
67	Quainton	Oxon	7	3	U	1830	4
68	Maud Foster, Boston	Lincs	7	3	0	1819	2

Drive: 0 = overdrift, U = underdrift.

The survey was based on published (and therefore accessible) data only. In counting floors, basements are excluded (eg. Cranbrook, Kent), as are spurwheel hurstings in the ceiling of the floor beneath the stones (eg. Berkswell, Warks). Sometimes only partial floors survive (eg. Stanstead, Essex; Shiremark, Surrey); these have been counted as separate floors. In a few instances the stones sit on hursting above the main floor (eg. Shiremark, Surrey; Dalham, Suffolk); these have not been counted as separate floors. Only the locations of wind-powered stones have been noted. Finally, if there is evidence that the

mill has been altered, the earlier phase is noted (1) and the later one (2) (eg. Ashton, Somerset).

Sources

- 1) Coulthard A.J. & Watts M; Windmills of Somerset: 1978, London.
- 2) Wailes R; The English Windmill: 1967, London.
- 3) Wailes R; Windmills in England: 1975, London.
- 4) Guidebook for the respective mill.
- 5) Brunnarius M; The Windmills of Sussex: 1979, Chichester.
- 6) Major J.K; The Mills of the Isle of Wight: 1970, Skilton.
- 7) The Author; fieldnotes.
- 8) Moon N; The Windmills of Leicestershire and Rutland: 1981, Wymonham.
- 9) Farries K.G; Essex Windmills, Millers and Millwrights, vol 3: 1984.
- 10) Drawing (??)
- 11) Foreman W; Oxfordshire Windmills: 1983, Chichester.
- 12) Farries K.G, & Mason M.T; The Windmills of Surrey and Inner London: 1966.
- 13) Farries K.G; Essex Windmills, Millers and Millwrights, vol 2: 1984.
- 14) West J; The Windmills of Kent: 1979, London.
- 15) Flint B; Suffolk Windmills: 1979, Woodbridge.
- 16) Watts M, Cornmiling: 1983, Princes Risborough
- 17) Barnes J.S; A History of Caston, Norfolk (part 2): 1974, Orpington.

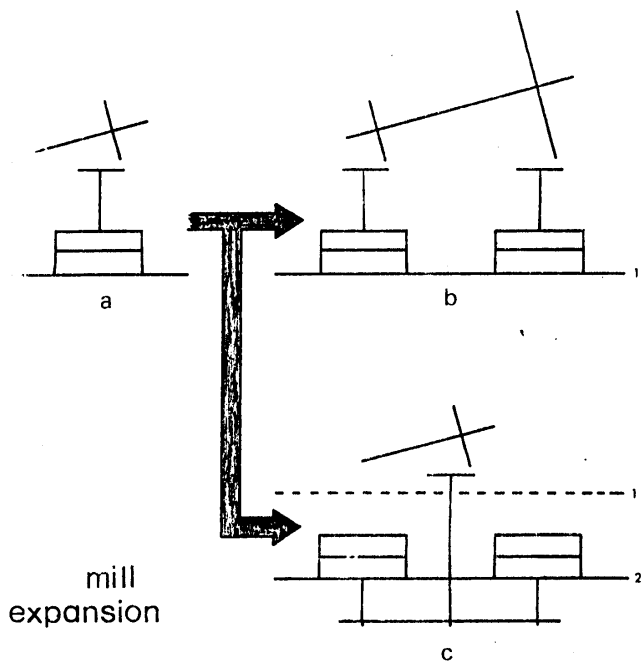


Fig 3.

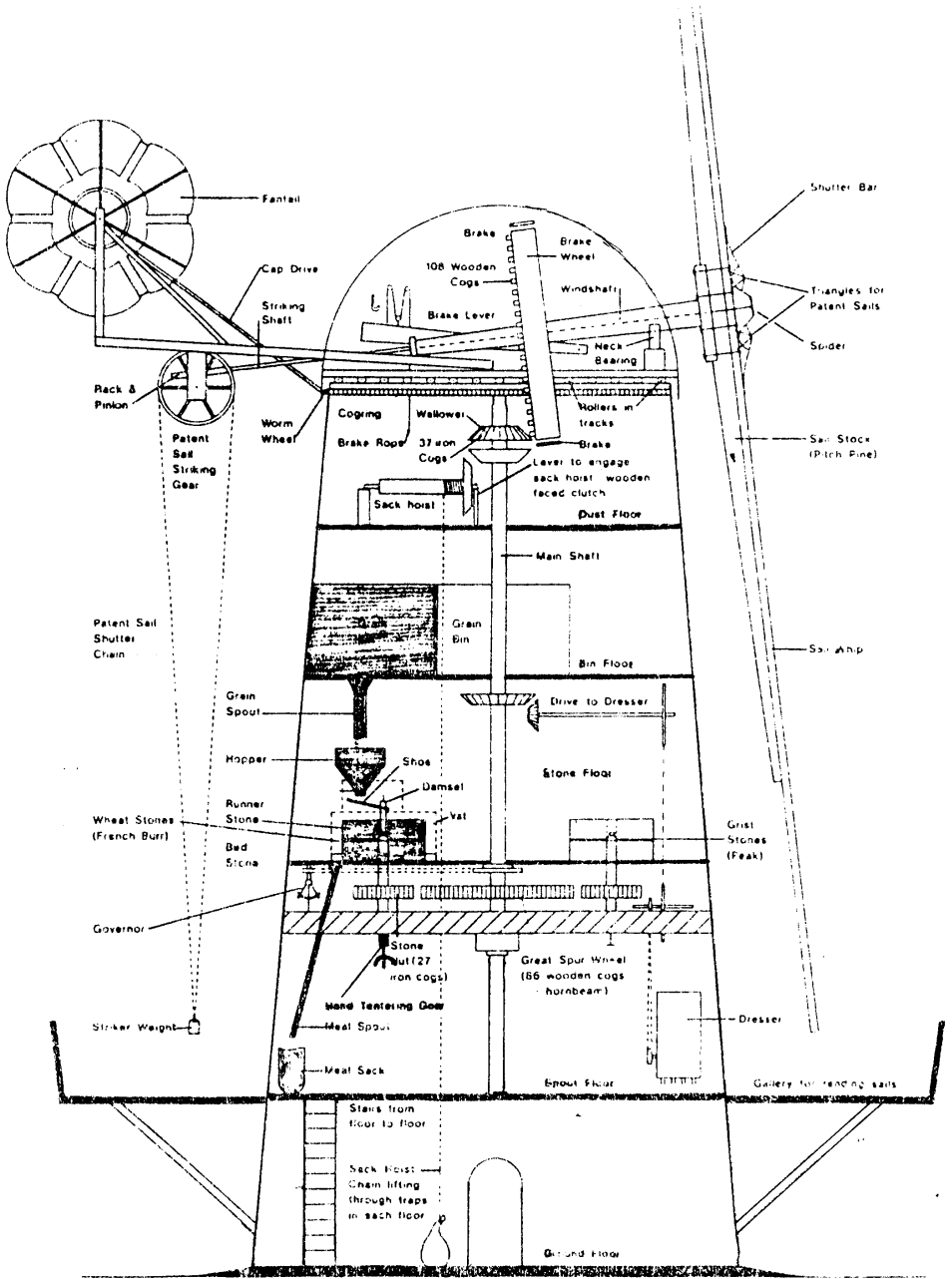


Fig 1.

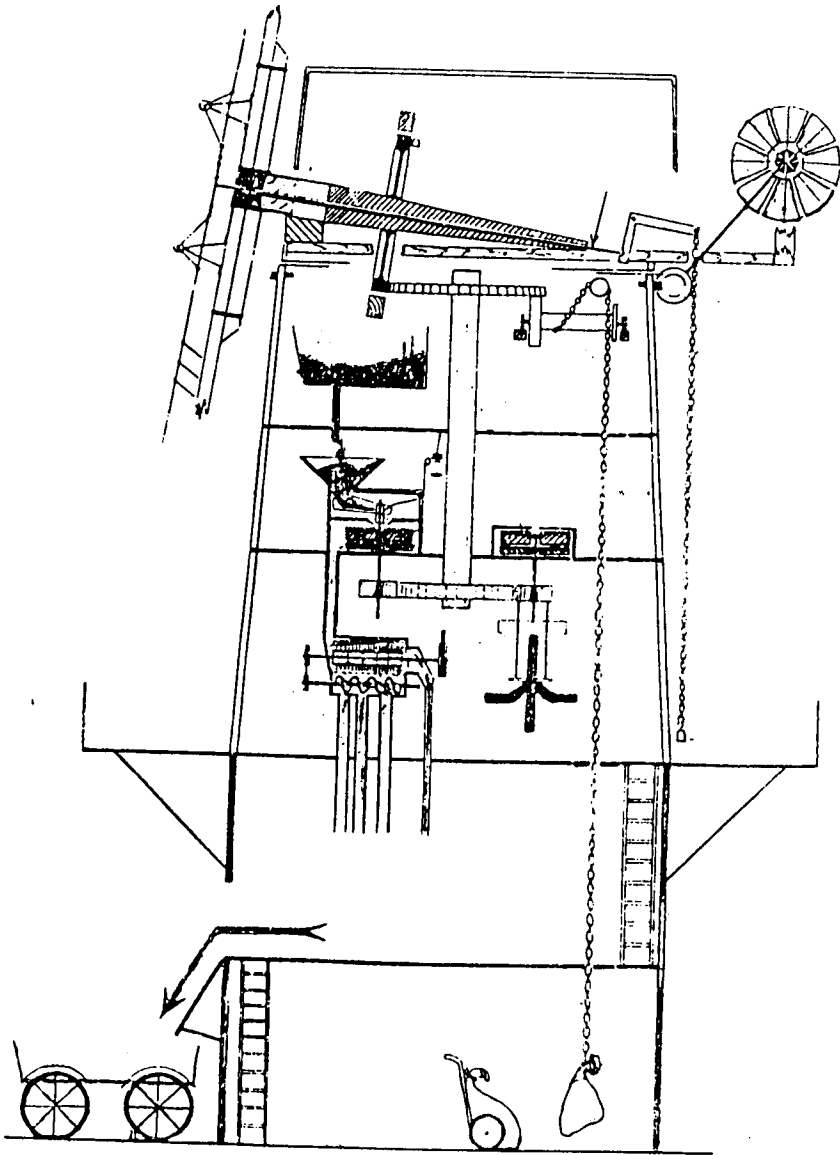


Fig 2.