

SAMUEL HARLOW OF ASHBOURNE AND HIS LONGCASE MOVEMENTS



by John A. Robey

THE traditional view of the development of the clock trade in Britain is that brass-dialed longcase clocks (the movements at least) were constructed by the 'maker' named on the dial, while painted-dial clocks, made after about 1770, had movements manufactured in Birmingham 'factories'. A typical statement is that:

standard-design movements [were produced] in the first 'steam factories' during the industrial revolution, and these movements were sold in their thousands to isolated clock factors in country towns, either for replacement or for fitting to new enamel [i.e. painted] dials.¹

Given that there was a revolution in manufacturing, initiated in industries such as ceramics and textiles – particularly as the new textile machines were largely built using the skills of clockmakers² – about the time that the new fashion began for clocks with colourful painted dials, this view was a reasonable assumption. But it *was* an assumption, largely fostered by the now-discredited notion that painted dials were introduced as a cheaper alternative to the traditional brass dial. It does not take the examination of many movements fitted to painted-dial clocks, before it is realized that, while they do not have the individuality and downright quirkiness of many of the earlier ones, these 'standard' movements do show a wide diversity in the shapes of their components, particularly the strikework. Very few movements are *identical*, and even those that are very similar and clearly come from the same workshop, such as the Harlow movements discussed here, are rarely the same in every detail. If they had been manufactured in a few

large factories, then much smaller divergences would be expected.

Current opinion is that these movements were sometimes made by the person named on the dial, but increasingly by a large number of small workshops making movements primarily for sale to others, who would retail them complete with bought in dials and with locally-made cases. It has often been assumed that this was a phenomenon brought about by the introduction of the painted dial, but in reality many clockmakers sold movements to other makers, while at other times may have even bought movements back from these same tradesmen. This practice had been going on since the seventeenth century – even clocks bearing the names of well-known London clockmakers sometimes have movements with all the signs of having been made in the workshops of others. It has also been proposed that many lantern clocks from the seventeenth century were made by a few London makers who wholesaled them with the name of the retailer on the dials, rather than the name of the actual maker.³

The introduction of the painted dial merely accelerated a process that had been in existence for almost a century. Initially, those clockmakers that made their own movements continued to do so, and they can be recognized by the front plates still showing planishing marks, or even sand marks from the casting mould, and usually the scribed lines and circles indicative of an individually-made movement.⁴ Examples of movements made individually by the clockmaker for his own customers, as well as those bought from movement manufacturers, have recently been published.⁵ The actual makers of

1. K. Ullyett, *In Quest of Clocks*, (London: Spring Books, 1968), p. 248.
2. J. A. Robey, 'Of Clocks and Cotton', *Clocks*, (March 1992), 14-17.
3. G. White, *English Lantern Clocks*, (Woodbridge: The Antique Collectors Club, 1989), pp. 204-5.
4. J. A. Robey, 'Marking Time', *Clocks*, (August 1994), 12-16.
5. J. A. Robey, *The Longcase Clock Reference Book*, (Ashbourne: Mayfield Books, 2001), chapter 8.

some of these 'standard' movements have been identified, but most are anonymous.

Although it is difficult to quantify, it appears that about 1800 was the watershed, before which many clockmakers still made their own longcase movements. After the turn of the century, clockmakers increasingly turned to movements manufactured primarily for sale to the clock trade, but some made their own movements to the end of the longcase era.

Movements made for the trade, i.e. the type that we are considering here, are generally characterized by the following features:

- Rectangular plates with no arched gaps or extensions. Usually relatively squat, typically 6¼ in. tall by 5 in. wide, compared to earlier ones with plates about 7 in. by 5 in. (Shaped top corners sometimes occur, but are more usually associated with the movements of nineteenth-century spring clocks.)
- Plain pillars, sometimes rather slender with small knobs, particularly on late movements.
- Smooth front plates, with no casting or planishing marks. (But the plates are variable in thickness, as they were made from castings, not rolled sheet. Striations where the scraper marks have not been completely smoothed away are sometimes seen, indicating that these movements were still made by hand, not machine.)
- No marking-out circles or lines scribed on the front plates.
- Very competently made, with square edges and a good finish to all the iron work.
- Collets with long extensions.
- Standard layout with rack striking and pallet-tail locking.
- Wheels (invariably slit with the same width cutter) have counts and diameters that give adequate tooth thickness to all wheels. In comparison, many earlier movements have very thin teeth on some wheels, especially the warn wheel.

It must be emphasized that traditional clockmaking techniques were still used: wheels

were rounded by hand filing to suit pre-drilled pivot holes, rather than depthing wheels with pre-shaped teeth and then drilling the pivot holes, as is done nowadays. The main improvement to speed up production rates appears to have been an increased use of jigs, in particular for marking out the positions of all the pivots and other holes in the plates. While a drilling jig could have been employed, it would have been subject to wear. Instead a master plate fitted with a number of centre punches was possibly employed, so that the position of all the holes could be marked with one swing of a fly press. The holes were then drilled through with a bench-drilling machine. Master 'spotting plates' like this were certainly used in the early twentieth century at the Ashbourne works of William Haycock, which can trace connections with one of the Harlow firms.

The identification of the actual maker of any individual nineteenth-century longcase movement is frustrated by the lack of distinguishing names or initials stamped on the plates of most movements. Although some are known, they are often the name of a wholesaler, rather than the actual maker. While some of these manufacturers were based in Birmingham, a major source of painted dials, many were working elsewhere. In Bristol an important firm was Thomas Hale, who in partnership with Richard Wasbrough traded as Wasbrough, Hale & Co until 1848, then as Thomas Hale & Co. It was claimed that they, or their predecessors, had made 39,861 house clocks since their establishment in 1726 to 1858 – an *average* of 300 clocks a year over the whole period.⁶

Another important location for clock production was Newcastle-under Lyme in north Staffordshire, which 'employed about 150 clockmakers, manufacturing for the trade in different parts of the kingdom – a greater number than any other provincial town if we except Birmingham'.⁷ One of these was William Bayley, a clock manufacturer and brass founder employing eight men and three apprentices in 1851, but only four men and two boys ten years later. Despite the fact that several thousand

6. C. N. Ponsford, 'The Independents of Bristol', *Clocks*, (May 1979), 20-1.

7. M. H. Miller, *Old Leek*, vol II, (1900), based on the evidence of the nineteenth-century Leek clockmaker William Travis. Quoted by A. A. Treherne, 'British Clocks, 1700-1900, A Review', *Antiquarian Horology*, 11/2 (Winter 1978), 184-205.

movements must have originated from his workshop, no clocks are known signed by him and no movements can be attributed to him.⁸

Fortunately, the movements made by one of these trade manufacturers, Samuel Harlow of Ashbourne, can be identified, as he published a booklet containing details of both his components and finished movements, eight-day and thirty-hour, with some quite distinctive and recognizable features. The frequency with which these movements are seen indicates that Harlow was one of the most important, if not *the* most important, of these movement manufacturers.

SAMUEL HARLOW AND CLOCKMAKING IN ASHBOURNE

Ashbourne is a small market town on the western side of Derbyshire, close to the romantic scenery of Dove Dale and other places in the Peak District. It was on the main turnpike road from Derby to Manchester, and there was also a regular coach service to Birmingham, via Uttoxeter and Lichfield every Sunday, Tuesday and Thursday. In the eighteenth century it became a fashionable town, having associations with Dr Samuel Johnson, Jean Jacques Rousseau, and Dr Erasmus Darwin, and while it could not compete with larger places, such as Nottingham, Derby or Lichfield, it became popular with fashionable society, and many fine Georgian buildings were erected.⁹ There was thus a ready market for items such as clocks, so it is not surprising that Ashbourne became an important centre for their manufacture, and its clockmakers developed into making movements for the trade, rather than just the local gentry. Over seventy clockmakers have been recorded in the town – only exceeded in the county by Derby and Chesterfield, both much larger places and out of all proportion to its size.¹⁰

Surprisingly, although Derby is only about fourteen miles from Ashbourne, there seems to

have been very few horological connections with the county town, despite the influence of the apprentices of John Whitehurst and his successors on the region. In the first half of the nineteenth century clock production in Ashbourne concentrated on longcase movements, but later the town's manufacturers made movements for spring clocks and skeleton clocks. When one of these firms closed in 1913, the sale included 600 fusee dial-clock movements, 500 incomplete pressure gauge movements in cases and 100 turret clocks.

Most published information on Ashbourne's clockmakers has been derived from a small booklet by W. Smethurst, published in 1940.¹¹ While the information for the nineteenth-century and later appears to be reliable, that on the eighteenth century is less so, and appears to have been based on oral tradition. Furthermore, it is not always clear which particular member of a family is being referred to, and this has caused confusion. Recent searches of the International Genealogical Index (IGI) have confirmed some facts, disproved other details, and provided vital new evidence.

It is said that Joseph Harlow introduced:

the trade of Brassfounding and Clock-making, for which the town eventually became a noted centre. He learned the trade in Birmingham and commenced the small business at Summer Row, and Ashbourne in 1740, these being afterwards greatly developed by his son Samuel.¹²

But there is no record of a clockmaking apprenticeship,¹³ nor with whom he worked, nor references to any other relevant Harlow in Birmingham directories or rate books.¹⁴ In any event Summer Row did not exist in 1740, and even on Thomas Hanson's plan of Birmingham in 1781 it was still an unnamed hedge-lined lane in open countryside, being an extension of Congreve Street. Summer Row only began to be developed around the time of Hanson's

8. Information from A. A. Treherne.

9. A. Henstock, *A Georgian Country Town, Ashbourne 1725-1825, Vol 1, Fashionable Society*, (Ashbourne Local History Group, 1989), *passim*.

10. R. G. Hughes, & M. Craven, *Clockmakers & Watchmakers of Derbyshire*, (Ashbourne: Mayfield Books, 1998).

11. W. Smethurst, *The Old Clockmakers of Ashbourne*, (1940), 15pp., (reprint of articles from the *Ashbourne Telegraph*).

12. *ibid.*, p. 2

13. Information from D. Moore, Prescott Museum.

14. Information from J. McKenna.

survey, as businesses here were first mentioned in directories in 1780, and by the middle of the decade it was the location for a number of tradesmen. It was not Joseph Harlow, but his eldest son Samuel who had business connections with Birmingham in the early nineteenth century (see later), which gave rise to the tradition that Joseph introduced clockmaking and brassfounding to Ashbourne from Birmingham. But Ashbourne had had a thriving clockmaking tradition from the early eighteenth century, the main concern being the Ashton family, who came to the town from Macclesfield in Cheshire, via Tideswell, Derbyshire. Joseph Harlow appears not to have been a clockmaker, more likely a builder, as the family erected and repaired many of the town's Georgian buildings.¹⁵ If Joseph had been a clockmaker he would have trained his eldest son himself, rather than indenturing him to one of the established Ashbourne clockmakers.

In 1750, when aged forty-five, Joseph Harlow was married (for a second time) to Mary Boulton, who does not appear to have been related to Matthew Boulton, the noted Birmingham industrialist, as Smethurst suggested. Instead of following the family trade as builders and bricklayers, three of Joseph's sons became clockmakers: Samuel Boulton Harlow (1751-1820/25), John Boulton Harlow (1753-1817) and Benjamin Boulton Harlow (1764-c. 1809). The middle christian name of Boulton was later dropped.

John Harlow traded as a clockmaker in Smith's Yard, Compton, Ashbourne, and was succeeded by his son Thomas, who retired in 1826 after selling his business to two brothers John and Thomas Haycock, who had learned the clock trade with the Harlows. The descendants of Thomas Haycock are still active as clockmakers in Ashbourne.

Benjamin Harlow, who was thirteen years younger than Samuel, probably trained with one of his two brothers, before he married in 1788 at nearby Mayfield and moved to Lane End,

Longton, to become one of the leading clockmakers in the Staffordshire Potteries. He took an apprentice while he was at Lane End in 1790, and at Stoke-on-Trent in 1793 and 1794. In 1803 he advertised for two journeymen clockmakers 'wanted principally for the retail trade', so he may not have attempted to compete with his two older brothers in Ashbourne as a movement maker. He had died prior to 1813 when his widow, who had run the business for a while, handed over to their son Benjamin Harlow II (born about 1793), when he would have been twenty or twenty-one years old and just out of his apprenticeship. Benjamin Harlow II also worked in Macclesfield, Cheshire, for a while, as a son was born there in 1832 and he is recorded in *Pigot's Directory* at Mill Street, Macclesfield, in 1834. By 1851 he was back in The Potteries, living in Shelton, next door to John Massey, dentist and clockmaker, father of Edward John Massey of Liverpool, clock and chronometer maker, and probably a brother of Edward Massey of Newcastle-under-Lyme, Hanley, Coventry, Prescott and London.¹⁶

Joseph Harlow's eldest son, Samuel Harlow, was apprenticed to John Litton, a prominent Ashbourne clockmaker, who had himself been apprenticed to Samuel Ashton. Samuel Harlow was apprenticed in 1767 for the usual seven years, so he would have started work on his own in St John's Street, Ashbourne, some time after 1773. In June 1777 he advertised in the *Derby Mercury* for a journeyman clockmaker (i.e. one who had finished his apprenticeship and was fully qualified), and also announced that he supplied 'the standard weights for weighing gold coin and scales properly adjusted by Mr Whitehurst'. Three months later he married Elizabeth Bottom of Derby.¹⁷ He advertised again for two journeymen clockmakers in 1788 and for another in 1797. By 1791 he was casting brass parts for clocks, textile mills, etc, as evidenced by the following advertisement:

Samuel Harlow takes the opportunity of informing all Cotton Manufacturers,

15. A. Henstock, *A Georgian Country Town, Ashbourne 1725-1825, Vol. 2 Architecture*, (1991), pp. 45, 48.

16. Information on Benjamin Harlow from Alan Treherne.

17. Smethurst is confused about Samuel Harlow's wife. He states: 'His wife's surname is unknown, supposed to be Richardson, but it cannot be proved definitely, her christian name was Elizabeth Hannah.' The IGI has shown that, like his father, Samuel married twice, firstly to Elizabeth Bottom, secondly to Hannah Howard, while it was Samuel's younger brother, Benjamin, who married Hannah Richardson.

Clockmakers, and others that he has lately erected a complete 'Foundery' for the purpose of casting brass, etc.

In 1802 a 'sober steady man' was required as a brass caster by Harlow & Son, i.e. Samuel and his son Robert, who was born in 1779.¹⁸

Samuel Harlow made many good-quality clocks, both thirty-hour and eight-day,¹⁹ supplied the trade with both parts and movements, and was described as:

a remarkable clever clockmaker of his day and generation, he introduced the principles of efficiency when rule of thumb methods were employed, by doing this he produced a better clock and a greater output, which enabled him to meet the competition of those days.²⁰

In 1794 he invented and patented (Patent No. 1708) a key to prevent damage to watches if wound in the wrong direction, often attributed to Breguet. Only one apprentice is known: David Smith in 1791 for seven years, but there must have been a number of other employees at the Ashbourne works, as two other nineteenth-century Ashbourne clockmakers trained with Harlow. It was said that: 'His main output of clocks and materials was supplied to the trade at Birmingham and elsewhere'.

Samuel Harlow's wife died in 1799 and the following year, aged forty-nine, he married again. He was still alive in 1820, but was dead by 1825. The business was continued by his son Robert, then by Robert's sons Benjamin and William, the latter trading with his mother Amelia as A. W. Harlow & Son, after an accident led to Benjamin's early death in 1845. In 1851 the business, was sold to William Robert Davenport. Despite being only twenty-seven years old, William Harlow appears not to have had any enthusiasm for the clock trade, for thirty years later he was a grocer employing five

men, in the Potteries town of Burslem. William Davenport had learned the trade with the Harlows and had commenced business under his own name in 1837. The Davenports were another important Ashbourne clockmaking concern, one branch continuing until 1939. The Harlow works was behind his house at 37-39 Upper St John Street, where it was continued by William Davenport, who 'employed quite a number of men there', but how many is not known. The workshop was pulled down in the 1930s when the roof fell in.

SAMUEL HARLOW'S BIRMINGHAM CONNECTIONS

The only known occurrence of Samuel Harlow in documents relating to the clock trade is in the Stubs papers, when he twice wrote to Peter Stubs of Warrington on behalf of John Masgreave of Birmingham: in October 1812 regarding the supply of cast brass clock parts to Stubs, and in May 1814 chasing an overdue order for pinions.²¹ Masgreave (or Masgrove) was a brass and bell founder and movement maker working in Summer Row, Birmingham, from at least 1812 to 1818, and was an important supplier of clock parts to Stubs. In 1807 John Masgreave married an Elizabeth Harlow in Ashbourne, almost certainly Samuel Harlow's daughter.²² John Masgreave is not recorded as having been apprenticed as a clockmaker, more likely he trained as a brass founder.

It seems likely that, sometime prior to 1807, during a business visit to Ashbourne, John Masgreave met and subsequently married Samuel Harlow's daughter. While there is no evidence for a formal business partnership, it may have been on a more informal father/son-in-law basis, as Samuel Harlow was certainly helping John Masgreave with some of his correspondence. The division of work between Asbourne and

18. Extracts from the *Derby Mercury* and other information on the Ashbourne Harlows from Adrian Henstock.

19. For example, Hughes, & Craven, op. cit., Figs 107-110.

20. Smethurst, op. cit., p. 3.

21. Stubs Papers, Manchester Archives & Local Studies. I am grateful to Alan Treherne for this reference.

22. Samuel Harlow 'the younger of Ashbourne, Gent and bachelor', son of Samuel Harlow of Birmingham, brassfounder, died in 1815, aged twenty-two, but he was 'Clerk to Johnson & Wise', and did not enter the family business. Smethurst has confused the death of Samuel jr with that of Samuel sr, and the exact date of the death of the later remains unknown. There is no trace of this son in the Ashbourne parish registers, nor in the IGL, so if this son has gone unrecorded it is highly probable that Elizabeth Harlow is also an unrecorded child of Samuel, particularly as she cannot be connected with any other Harlow in Ashbourne and her birth in 1781 (she was aged fifty-one when she died in 1833) was just a couple of years after that of Robert Harlow, Samuel's eldest son and successor.

Birmingham is not clear. The Ashbourne works was capable of producing both brass clock castings and completed movements, yet Samuel Harlow was described in 1816 as 'of Birmingham brassfounder'. In 1829 it was stated that Ashbourne had foundries where: 'clock-brasses are manufactured by Mr. John Frith and by Mr. Robert Harlow, in so superior a manner that they are in request throughout the kingdom'.²³ Masgreave only appears once in the Birmingham directories, in 1818 as 'caster in general, and bell founder, clock movements &c'. He may have acted as a more convenient trade outlet for the widespread distribution of Harlow's clock castings and movements than Ashbourne could provide.

In 1827 Masgreave owned a house in Ashbourne, formerly belonging to Samuel Harlow, but how involved he was with the Derbyshire end of the business is not known. John Masgreave died in January 1835, aged fifty-one, at Great Barr, Birmingham, a couple of years after his wife, aged fifty-two.²⁴

Birmingham must have continued as the main sales outlet for Harlow movements, for when the Ashbourne business was finally disposed of in 1851 'also the Birmingham stock was sold'. It is possible that movements were simply stored with their main wholesaler, rather than the Harlows having their own premises in Birmingham.

THE CLOCK MAKERS' GUIDE AND HARLOW'S MOVEMENTS

Samuel Harlow appreciated that clockmakers did not have the same freedom when making movements to suit painted dials as they had had with brass dials, so a greater degree of standardization was necessary. A brass dial could have the holes for the winding squares and seconds arbor drilled to fit an already made movement, but there was much less latitude with a painted iron dial. While some painted

dials were supplied with just small winding holes to be opened up by the clockmaker to fit the movement,²⁵ the seconds arbor had to be in exactly the correct position (usually 2 in. or 2½ in. above the centre). Problems associated with positioning the dial feet were largely solved by the dialmaker supplying a falseplate of cast iron, later of wrought iron, although many clockmakers managed without them, even for eight-day movements.

To avoid such potential problems, in 1813 Samuel Harlow published *The Clock Makers' Guide* (Fig. 1), a booklet of fifteen pages, ostensibly to encourage the standardization of longcase movements.²⁶ It was printed and sold in Birmingham by Orton & Hawkes Smith, 'also by the author, Summer Row, And at his House, Ashbourn, Derbyshire', as well as by the London clockmakers Handley & Moore in Clerkenwell Close, and at Walker's & Son tool shop, Red Lion Street, Clerkenwell. What

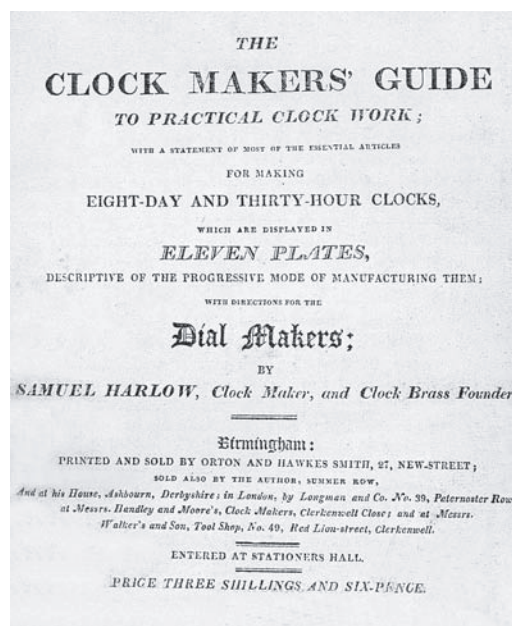


Fig. 1. The title page of Samuel Harlow's booklet, published in 1813.

23. S. Glover, *The History, Gazetteer and Directory of the County of Derby*, (1829), p. 234.

24. Death notices in the Birmingham newspapers, courtesy of J. McKenna. Apart from his marriage, there are no records of John Masgreave's birth or any children in the IGI.

25. J. Ballinger, 'Shedding Light on the Longcase White Dial', *Antiquarian Horology*, 20/2 (Summer 1992), cover and 154-5. The author has seen another with the original small winding holes intact and knows of further examples.

26. Copies exist in the British Library and Birmingham Central Library. A reprint, with biographical information taken from Smethurst, and Harlow's watch key patent was published in 1978. Unfortunately the plates were redrawn, not only losing all the character of the original engravings and at a different scale, but errors were introduced. All the plates, including those not shown here, are reproduced in full-size facsimile in *The Longcase Clock Reference Book*.

influence this booklet had on other movement makers is difficult to determine, as it is now extremely rare, with only two copies of the original known to exist. This might indicate that it was not widely circulated among the working clockmakers for whom it was intended, but it is likely that it served a dual purpose, also acting as a trade catalogue of Harlow's clock movements and parts. He stated that:

S. Harlow respectfully informs the Trade that he manufactures Moon Wheels, to fit any size dial, also Caliper Plates correct for Dial Makers ... Likewise may be had of him, Chime quarters, or plain Movements, made by the best hands (to go with Spring or Weight) also engines, Lathes, Tools, Files, or Materials proper for the Business of Clock Making.

This booklet has often been referred to regarding the standardization of movement layout, and it has been said that:

Parts from one clock could not be fitted directly into another made by the same maker, individual components had to be made when replacements were required. Samuel's methods enabled standard components to be fitted to all clocks, ensuring a greater output of parts for a given amount of labour, enabling him to meet his rivals' competition easily through lower prices.²⁷

In fact all that he advocated was 'that if Dial and Movement Makers observe the rules here laid down, the movements and dial will fit with the utmost exactness – the Pinion Makers may also make their pinions to size' and there is no mention of interchangeability of parts.

In the 1960s and 1970s, the argument as to whether it was the dialmaker or movement maker who supplied the falseplates, was settled by reference to Harlow's statement that 'the back plate, commonly used by the Birmingham Dial Makers, which if put on correct, might save the workman a great deal of trouble.'

Other than this *The Clock Makers' Guide* does not appear to have been studied seriously, and from the lack of comment it must have been assumed that the engravings of movements and parts were merely schematic, rather than

realistic. This article demonstrates that they are in fact very accurate representations of Harlow's own products. Without these illustrations it is doubtful if the movements shown here would have, or could have, been attributed to their actual maker, and Samuel Harlow's important contribution to the clock trade would have gone largely unrecognized.

HARLOW'S EIGHT-DAY MOVEMENTS

Figures 2 & 3 shows Harlow's engraving of the front plate layout of an eight-day longcase movement and some of the parts. A number of characteristics may be noticed.

- The most distinguishable feature is the shape of the rack hook, particularly the C-curve near the pivot. This is purely decorative, as is the additional small point on the hook itself. The latter is not very noticeable on the engraving (and was ignored altogether in the redrawn 1978 reprint), but is more prominent on actual movements. It is a very important characteristic that can almost be regarded as a 'signature' to identify Harlow movements. While it might be thought that the rack hook is of a traditional shape, it is a form that is not normally found in the eighteenth century.
- The rack has the stop pin on a raised section on the left-hand end, otherwise it is of a relatively simple shape. The rack is pivoted so that no cutout is necessary for it to clear the winding square when it has dropped fully.
- The warning flag is a separate tab (shown separately on the engraving) riveted to a circular end on the warning piece, rather than the end forged over at right angles, as was done by many other makers. (A riveted warning flag appears to be more usual on nineteenth-century spring clocks than longcase movements.)
- Other features are less distinguishable, and by themselves of little consequence, as some were used generally throughout the clock trade, but they assume greater significance when they occur together with the characteristic rack hook and warning piece. As will be seen, whenever a movement has the

27. C. K. Aked, & R. K. Shenton. Introduction to the reprint of *The Clock Makers' Guide*, (1978), p. 2.

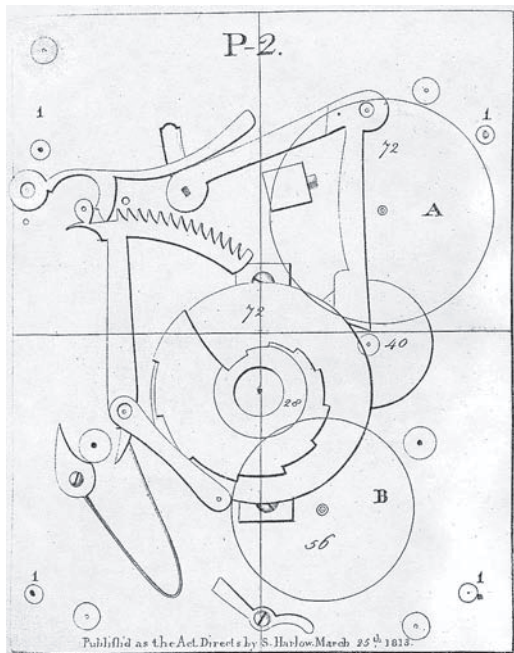


Fig. 2. Front plate layout of an eight-day longcase movement, as shown in *The Clock Makers' Guide*. Note the characteristic shape of the rack hook used on Harlow's movements. The warn flag that is riveted to the end of the warn piece is shown as a separate item. The click for the winding barrel was presumably intended to be included on one of the other plates.

same major features as Harlow's engraving, then the minor ones are also identical, or at least very similar. These minor features include:

- * Waisted rack tail with rounded end.
- * Shape of the thin brass lifting piece.
- * Rack pivoted just above and to the right of the winding square.
- * No crossings to reverse minute wheel.
- * Square-ended hour-wheel bridge positioned just a few degrees anticlockwise from the vertical.
- * Warning flag through a slot in the front plate, rather than a round or other shape of hole.
- * Position of the movement pillars.
- * The foot of the rack spring is screwed to the front plate close to the winding square.
- * Springs for the winding clicks riveted edge-on to the great wheels, rather than flat.

How does this engraving compare with actual Harlow movements? Figures 4 & 5 show a movement with a Walker & Finmore dial signed Robert Harlow, Samuel's son, who was probably running the Ashbourne side of the

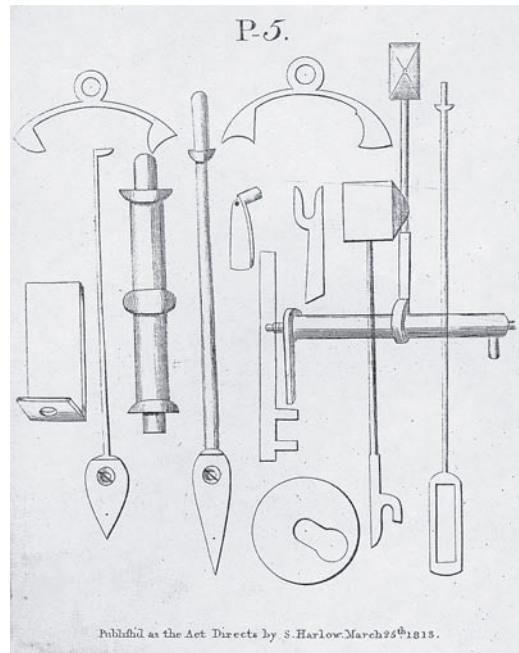


Fig. 3. Eight-day components. The hammer shaft is shown in the centre of its arbor, with a separate counter (far left), but Harlow usually had the hammer at the end of the arbor and no separate counter. The spring for the winding click has two lugs that are riveted to the greatwheel, as used on Harlow movements. Note the forked ends of the hammer shaft and the hammer tail, which fit into slots on the arbor. This arrangement is sometimes found on Harlow movements (Fig. 28), but not always.

business by this time. Although they were very prolific Birmingham dialmakers, Walker & Finmore only worked together for three years from 1808 to 1811, hence this movement almost coincides with the publication of *The Clock Makers' Guide*, and is a good representation of the firm's output at the time. Both the major and the minor characteristics are almost identical to Harlow's engraving, and the resemblance is so close that the engraver was probably given a movement with instructions to copy it precisely.

Having confirmed that Fig. 2 is an accurate representation of a Harlow movement of the 1808-11 period, when did Samuel Harlow produce his 'standard' layout? Figure 6 shows the movement of a clock with a round painted dial by James Wilson, Birmingham, signed Samuel Harlow. Many of the features of this movement are quite unlike those used on Harlow's later 'standard' design. For instance, the warn flag is forged on the end of the lever rather than a separate tab riveted on, the lifting piece has a different shape, the reverse minute

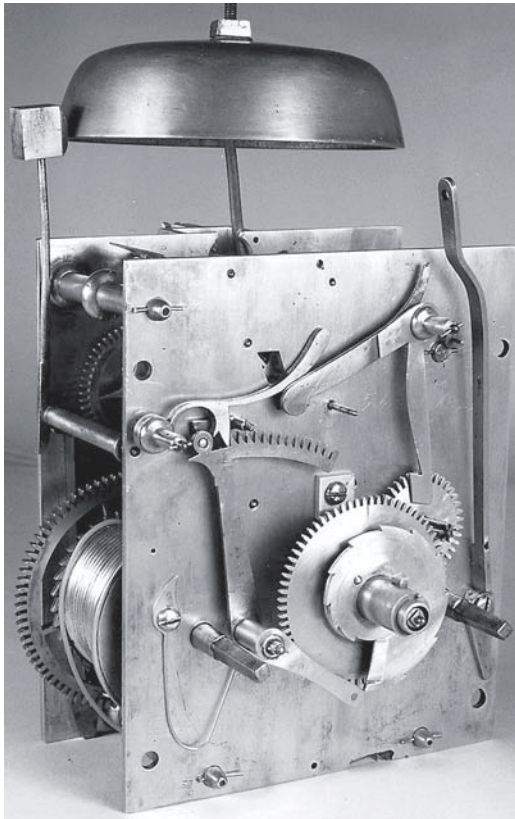


Fig. 4. Movement fitted to a dial signed by Robert Harlow, Ashbourne, made by Walker & Finemore, Birmingham, 1808-11. Note the similarity to the engraving in his father's booklet, especially the C-curve and the double point on the rack hook, the latter being a Harlow 'signature'. The warn flag is riveted to the circular end of the warning piece. Repeat spring fitted, but the upper extension to the lifting piece has been broken.

wheel has crossings and is pivoted in a cock, the bridge for the hour wheel has rounded ends, while the slot in the front plate is trapezoidal rather than rectangular. The bell stand does not pass through the backcock, which is the usual Harlow arrangement. Unfortunately, in the photograph the rack hook is obscured by the tail of the gathering pallet, so it is not known if it has the 'double hook' characteristic of later Harlow movements.

Figure 7 shows the movement of a clock with a silvered round dial signed by Tobias Fletcher of Barnsley, having all the features expected on one by Harlow. As it has a brass dial this clock might be thought to be earlier than Samuel Harlow's with its painted dial, but assuming that the movement in the latter was made before his movement design became standardized, then the painted dial clock is

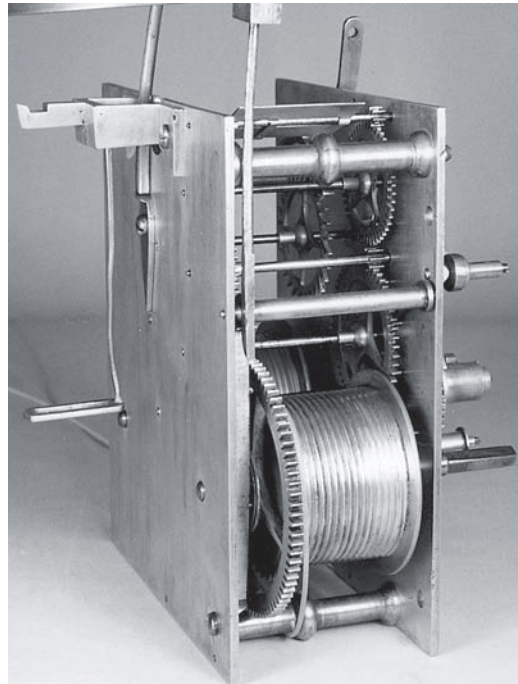


Fig. 5. Side view of the Robert Harlow movement, showing the bell stand passing through the backcock, a Harlow characteristic. Hammer at the rear end of its arbor. Pillars with undecorated rounded knobs, and wheel collets of a typical nineteenth-century top-hat shape.



Fig. 6. Unrestored movement from a clock with a round painted dial by Wilson, Birmingham, signed Samuel Harlow, Ashbourne, probably from the 1780s. This movement differs from other Harlow movements in nearly all respects. Unfortunately the gathering pallet obscures the rack hook.

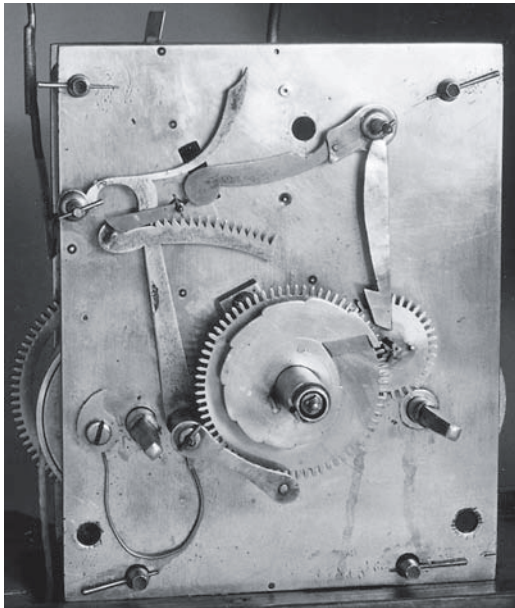


Fig. 7. Movement of a clock with a round brass dial signed Tobias Fletcher, Barnsley, probably from the 1790s. The rack hook is rather steeply upswept, and the rack has a rounded left-hand end, and although the tail of the gathering pallet obscures the hook, it is of the characteristic Harlow type. Warning piece cut away to clear the top dial foot.

probably from the 1780s, while the brass dial is likely to date from the 1790s. There was considerable overlap between painted and brass dials, nevertheless the movement in the Fletcher clock appears to be the earliest standard Harlow movement seen by the author to date.

Exactly when Harlow's standard layout was produced is not known, but it appears to have emerged as a fully-developed design, without any evolutionary stages. There may well be other early Harlow movements on clocks signed by others, and so not recognised as his work, hence this point will not be clarified until other early clocks signed by Harlow can be examined.

Other examples of these movements, fitted to dials signed by other 'makers', are discussed in approximately chronological order, the dates being determined by dial features and/or biographical information. Figure 8 shows the movement of a clock by Haylor, of Chatham, Kent, with a dial by Wilkes & Baker, Birmingham, who were working 1815-20. The oak case is typical of Kent from the early nineteenth century, with a Kentish cresting. William

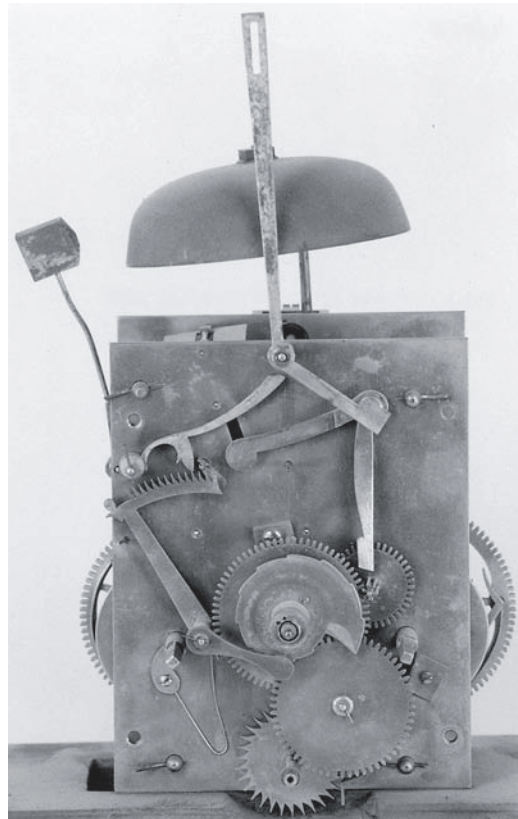


Fig. 8. Harlow movement fitted to a clock signed by Haylor, Chatham, with a Wilkes & Baker, Birmingham, dial, about 1815-20. Addition of a strike/silent lever, also a starwheel and 24-hour wheel (called by Harlow a 'month wheel') for a pointer calendar.

Haylor has recorded dates of 1765-1851, so this is probably two men with the same name, maybe father and son.²⁸ The movement is identifiable as by Harlow, with the addition of a strike/silent lever and a starwheel for a pointer calendar. The side view (Fig. 9) shows features that are not shown in the engraving: pillars with round knops, the rather thin hammer head, the bell stand on the outside of the rear plate and passing inside the backcock, and the L-shaped hammer spring with no stop or counter for the hammer. Harlow movements do not have a spring clutch behind the hour wheel for setting the hour hand.

It might be argued that some of the movements that have been attributed to Harlow might have been made by other clockmakers to Harlow's specifications in his *Clock Makers' Guide*, and possibly using parts bought from Harlow. If this was the case then some of the

28. M. Pearson, *Kent Clocks & Clockmakers*, (Ashbourne: Mayfield Books, 1997), p. 161.

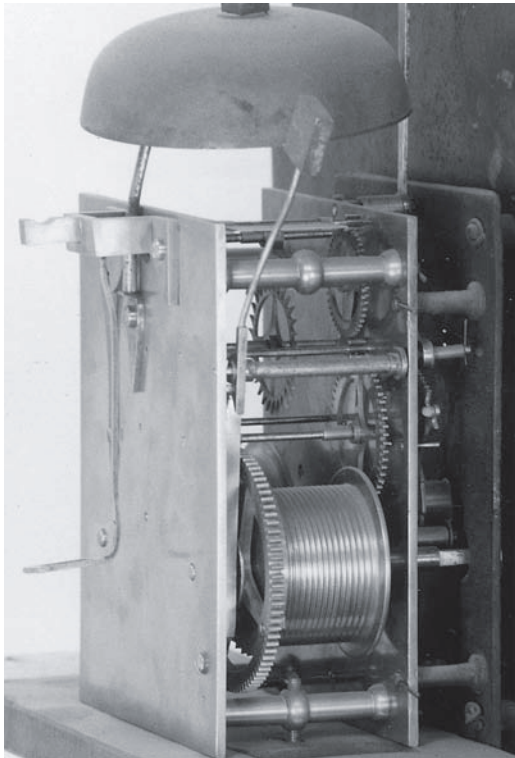


Fig. 9. Side view of the Harlow/Haylor movement, with the falseplate and dial in position.



Fig. 10. The front plate of the Haylor clock, with 'H. Knight' stamped on the bottom edge and '1111' above it.

features not illustrated might be expected to be different. In practice if a movement shows the major features, then it invariably has all the minor ones as well, notably the position of the bell stand. Pillar shape, which is sometimes regarded as a good indicator of the maker is variable, often having a rounded central knob, but also a cylindrical knob was used, especially on later examples. All the movements shown here (with one exception) have the hammer at the rear end of its arbor with an L-shaped spring also acting as a stop or counter, yet the engraving of eight-day parts in *The Clock*

Makers' Guide (Fig. 3) shows a central hammer with a separate counter. These features all confirm that the movements discussed here came from the Harlow workshops, and were not made by others to his published designs.

The bottom edge of the front plate of the Haylor/Harlow movement, where it sits on the seatboard, is stamped 'H. Knight' (Fig. 10). One possibility is the clockmaker Hugh Knight of Stone, Staffordshire, who took five apprentices during 1786-93, and is probably the same man listed in directories in Stafford in 1818 and 1822.²⁹ A more likely possibility is Henry Knight, a maker of turret clocks, brass and bell founder, clock forge work and pinion maker, in Summer Row, Birmingham in 1818-20 and at Ann Street in 1821-50. A movement fitted to an S. Baker dial (1830-50) signed by J. H. Smith, Wrexham (1830-68) has been reported stamped 'M. Knight 2267',³⁰ but as illustrations are not available no opinion can be made of the source of the movement.

Why should H. Knight stamp his name on what is ostensibly a Harlow movement, and in such an inconspicuous place? The possibility must be considered that he made the movement to Harlow's published designs and using Harlow's castings and forgings. In this case the movement would be similar to Harlow's, but unless he had been trained by Harlow it is most unlikely that he would have made it so similar, and even included the Harlow 'signature' of the extra point to the rack hook. The most likely explanation is that Knight was one of a number of middlemen, buying movements from Harlow and selling them on to retailers, who would fit them into locally made cases. If the movement was returned for whatever reason, then Knight needed to be able to identify it as having been supplied by him, and not by another middleman.³¹ The name was certainly not for promotion, otherwise it would have been in a more prominent place. Who fitted the dial: Harlow the movement maker, Knight the wholesaler, or Haylor the retailer, is not known.

Another movement attributed to Harlow (Fig. 11) has 'O & J' with a crown above it, plus

29. Information from D. Moore and A. A. Treherne.

30. *Clocks*, (Jan 1983), 45.

31. I am grateful to Tom Spittler, who has come across a similar situation regarding late nineteenth/early twentieth century mass-produced clocks sold by middle-men, for this suggestion.

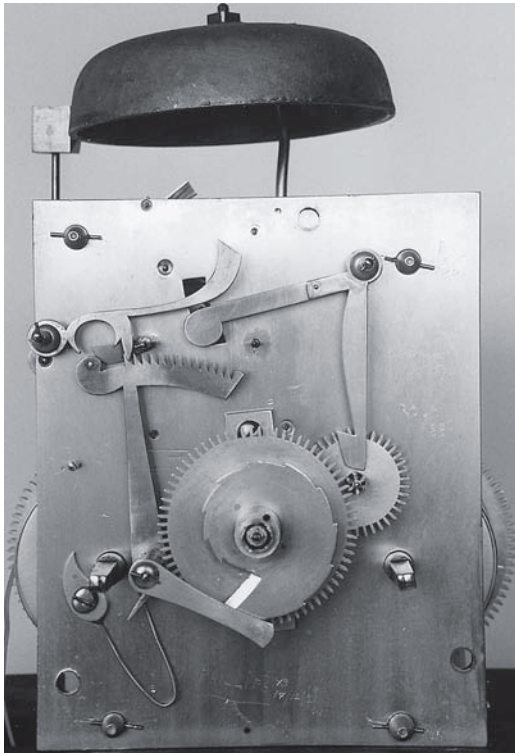


Fig. 11. Harlow movement fitted with a Finnemore & Son dial (1828-36) signed by Joseph Wilson, Chichester, Sussex.



Fig. 12. 'O & J' and crowns stamped on the top edge of the front plate of the Harlow/Wilson movement.

three other attempts at the crown alongside, stamped on the top edge of the front plate (Fig. 12). It has not been possible to identify O & J, but they are likely to have been another intermediary concern, supplying movements to retailers, and stamping their identifying mark for exactly the same reason as H. Knight. The movement has the Harlow features, but the end of the rack hook is wider and swept up more than shown in *The Guide*, the left-hand end of the rack shows differences, while the lifting piece near the pivoting stud shows some variation.

Four movements stamped 'J. E. Bagnall' have been reported on American-cased clocks one dated 1837, while another is clearly a identifiable as a Harlow movement.³² James

Eustace Bagnall is first listed in Birmingham directories in 1843 at Great Hampton Street, as a 'manufacturer of spring, skeleton and weight clocks, movements & clock materials of every description, bell founder, caster & lock manufacturer', although he was clearly working at least six years earlier. By 1855 he was only listed as a bell founder and had disappeared from the directories three years later. It is not known if all the wholesalers whose names appear on movements attributable to Harlow sold them in competition with each other, or if they had exclusive rights to their distribution. If the latter, then it may only have been on a regional basis, as a Harlow movement is known with the name of a Manchester 'clockmaker' stamped on it.

A number of movements are known on American-cased clocks with 'Wainwright No 1' stamped near the bottom of the front plate, one of them, dating from 1834-7, being a typical Harlow movement. It is quite likely that all the movements reported with both the Bagnall and Wainwright stamp are by Harlow, but further examples are needed to confirm this. Wainwright may be the well-known Nottingham family of clockmakers, but another possibility is James Wainwright of Birmingham, listed as a factor in 1829-32. 'No 1' does not indicate the movement number, but is probably its type, i.e. eight-day. It is likely that 'No 2' would refer to thirty-hour movements, but none are known, which is hardly surprising as thirty-hour movements with countwheel striking, as commonly made in England, were rarely used in the USA, rack striking being preferred. George Jones of Wilmington, Delaware, used a Harlow movement on at least one of his tall-case clocks in the 1820s.³³

Figure 13 shows a movement with typical Harlow characteristics, but stamped with the name of Edward Scales, Manchester. Scales traded in Manchester from 1835 to 1881, and in 1863 he advertised:

Quadrants for cotton spinners; manufacturers of plain, spring, quarter, turret and chime clocks, skeleton and watchmen's timepieces, regulators with mercurial pendulums, lever watches and etc. Manu-

32. B. R. Forman, *Clockmakers of Montgomery County* [Pennsylvania], (Historical Society of Montgomery County, 2000), p. 218. The name has been misread as T. E. Bagnall, rather than J. E. Bagnall.

33. Photographs by William Jones, Illinois.

facturers of telegraphic instruments; jeweller, dealer in electro-plate. Edward Scales begs to call the attention of watch-makers and the public to his establishment where every description of clocks and watches are manufactured in the best manner possible and at as low prices as is compatible with first-rate work. Clocks and watches cleaned and repaired on the premises. Improved portable roasting jack. Public and private clocks wound and etc. by the year.³³

Despite claiming to be a manufacturer, it is not clear how much he actually made himself, as the movement illustrated here was certainly bought in from Harlow. If he was a genuine manufacturer would he not have stated that the clocks and other items he sold were made 'on the premises', like his repairs? This emphasises that advertisements, particularly in the nineteenth century, and even names stamped on movements, cannot be taken at face value and corroborative evidence is necessary to establish the actual maker.

The side view (Fig. 14) shows that the movement has small ungrooved line barrels, the

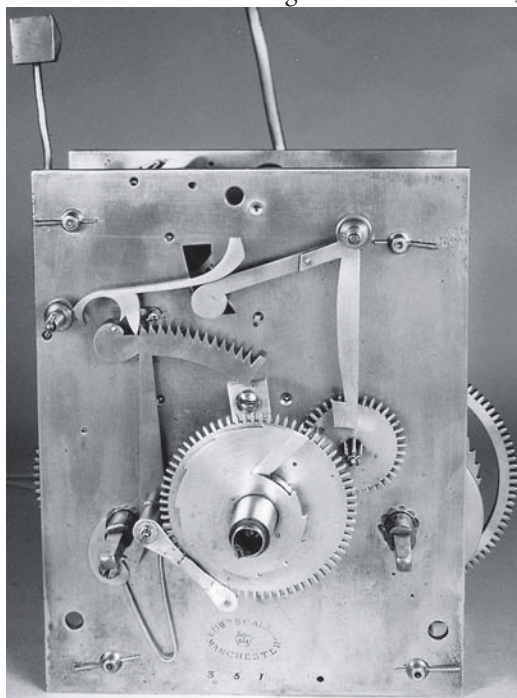


Fig. 13. Harlow movement stamped with the name of Edward Scales, Manchester, fitted with a Fletcher falseplate (1841-55).

33. Information from Edmund Davies.

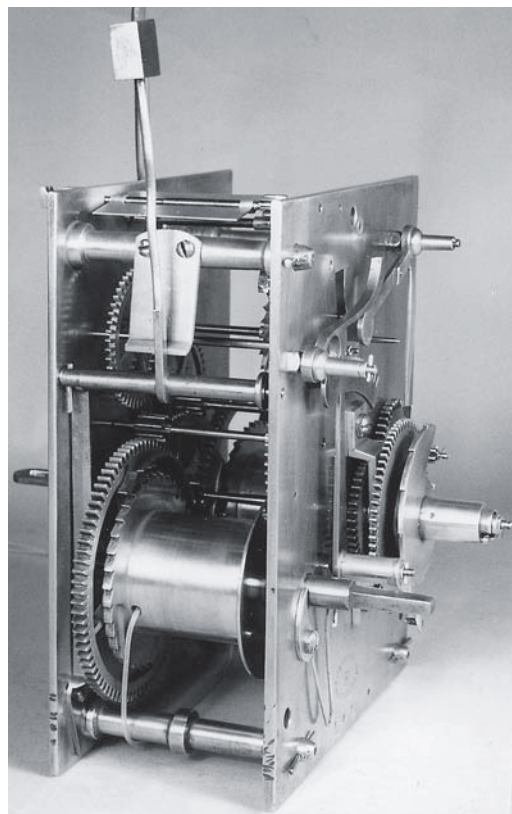


Fig. 14. Side view of the Harlow/Scales movement, with a central hammer and a separate counter screwed to the top pillar. The small diameter winding barrels without grooves indicate that this was originally from a clock with a short weight drop – either a long-trunk wall clock or, more likely, a cupboard clock.



Fig. 15. The Scales name stamp.

only 1 $\frac{3}{8}$ in. diameter, instead of the usual 2 in. diameter. The lack of grooves means that about twenty-four turns of line can be accommodated, compared with the usual sixteen, giving an extended period between winding. The small barrels necessitate heavier weights, which are dumpy and of lead, each of 14 lb, rather than cast-iron ones of about 12 lb. This movement

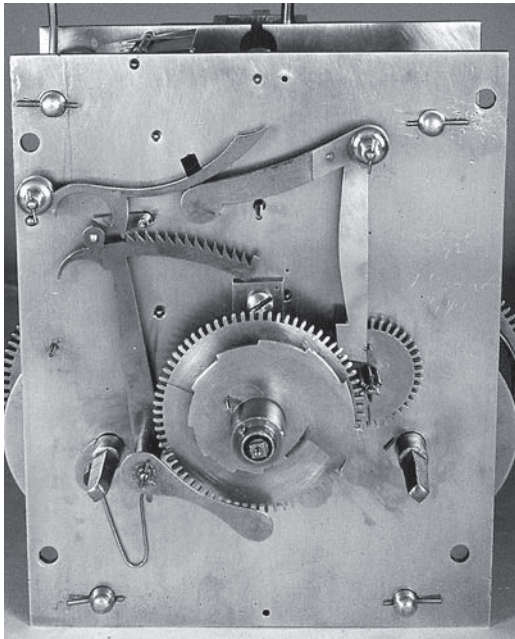


Fig. 16. Harlow movement on a clock with a dial made by S. Baker, Birmingham, signed Edward Thompson, Ellesmere, Shropshire, about 1830.

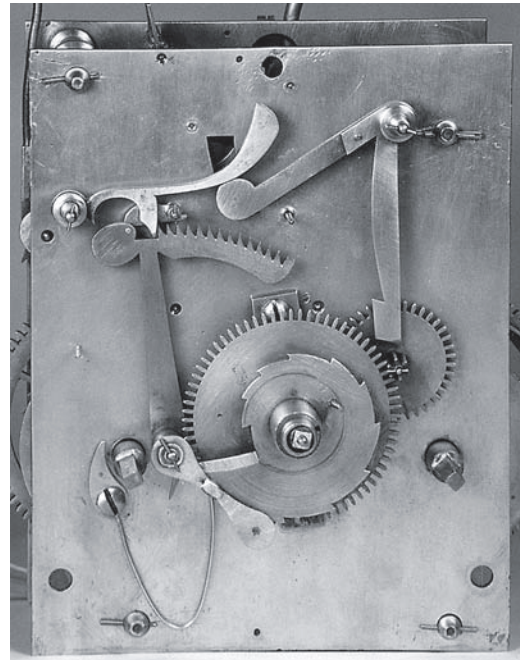


Fig. 17. Movement fitted with a Wright, Birmingham dial, signed Samuel Owen, Carnarvon, from the 1830s. The double hook has virtually disappeared, but all the other Harlow features are present.

was not made for a longcase clock (it is currently married to an earlier brass thirty-hour dial), but for a clock with a short weight drop, such as a cupboard clock or a long-trunk wall clock (popularly known as a 'Norwich' clock). Scales is known to have made a couple of long-trunk wall clocks, but the pendulum bob is shaped, probably to enable it to swing within the confines of the drawer frame of a cupboard clock. This movement also has the hammer shaft central on its arbor, with a counter screwed to one of the top pillars. Despite being the method shown in *The Clock Makers' Guide* (Fig. 3), this is the only example that has so far been seen on a Harlow movement. As often occurs in horology, there are exceptions to every rule.

A number of other similar movements attributed to the Harlow workshop have been seen by the author (Figs 16-18). To avoid tedious comparisons any differences with Harlow's engraving are discussed in the captions. In addition a number of Harlow movements have been illustrated in various issues of *Clocks* magazine, but without their origin having been appreciated. The main conclusion is that while all these movements are clearly from the same workshop, being

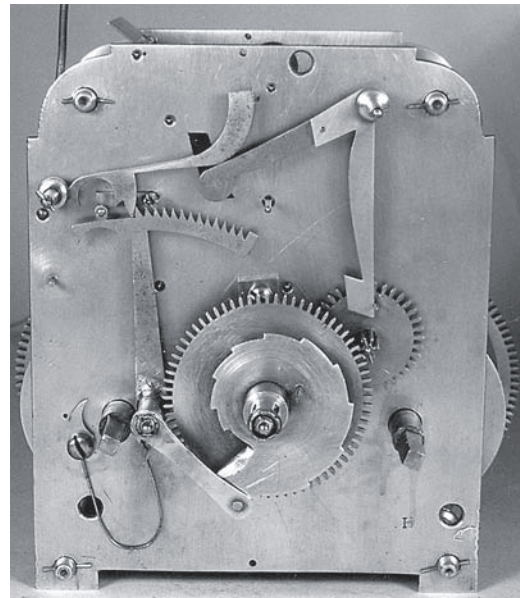


Fig. 18. Movement from a clock with a replaced Victorian or Edwardian brass dial, in a typical Midlands case (probably made in Uttoxeter, Staffordshire) of the 1840s or 1850s. The top corners and lower edge of the plates are shaped, otherwise it is a typical Harlow product. Stamped 'H' (Harlow?) at the bottom right.

made to the same design, there are some differences. Some of these variations are attributable to them have been made over a

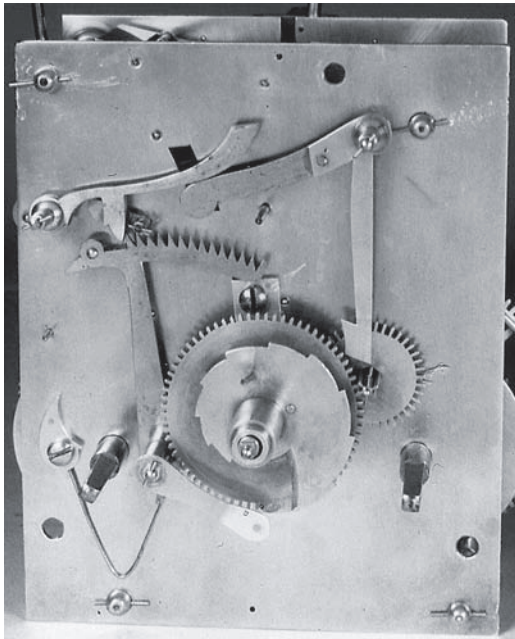


Fig. 19. Movement of a clock signed by William Davenport, Ashbourne, probably from the 1850s after he had taken over the Harlow works. The C-curve on the rack hook is no longer evident, but there is still the vestige of a double hook. Virtually the only other difference from a Harlow movement is a small hole and a vertical slot in the back plate for removal of the pallet arbor, instead of a round aperture.

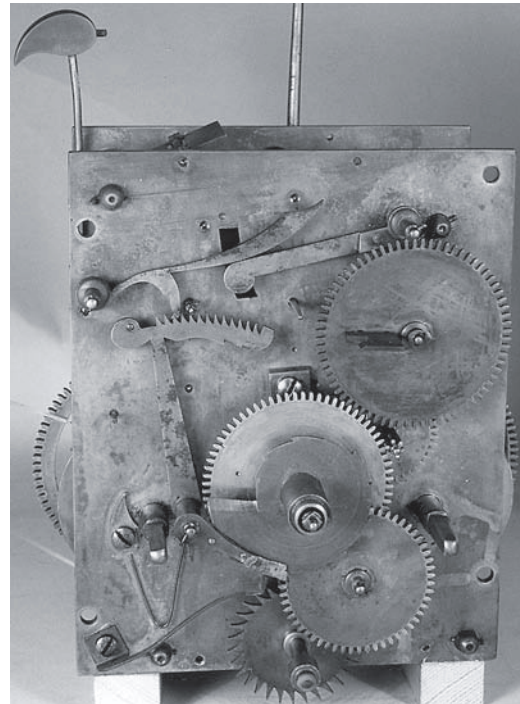


Fig. 20. Unrestored movement of a clock retained by Frederick Heitzman, Cheadle Staffordshire, dated 1859. Probably made by William Davenport, Harlow's successors, or one of the other Ashbourne movement manufacturers. The rack hook has lost the C-curve, but it still has a vestigial double hook.

sixty-year period. For instance new patterns might have had to have been made for pillars (three different styles can be recognized) due to loss or damage. Other differences might be due to the personal preferences of the individual workmen – some might be more inclined to make a decorative rack than others, for instance. The racks certainly show more variation than any other component and allowed the workman to show his individuality, but they all usually have the stop pin for the pallet tail on a raised-up piece. This confirms that, despite the obvious standardization in the layout, these movements were still individually made by traditional clockmaking methods. The pallet tail usually locks on a rack pin behind, or occasionally in front of the rack, possibly at the discretion of the individual worker. All Harlow movements are well made and neatly finished, and apart from the characteristic rack hook, the parts are elegantly shaped without unnecessary decoration. One

movement, clearly recognizable as having come from the Harlow workshop, but assumed to have been made by James Whitelaw of Edinburgh, the 'clockmaker' named on the dial, has been praised as 'a movement that is notably well made and finished throughout'.³⁵

Figure 19 shows the movement of a clock with a dial signed by William Davenport of Ashbourne, about 1850, and Fig. 20 is another one which was probably also made by Davenport. As he was trained by Harlow and bought the works in 1851, the similarity with Harlow movements at this period is not surprising. Apart from the lack of the C-curve on the left-hand side of the rack hook, these two movements have most of the Harlow features. By the 1840s it may be better to describe these as Ashbourne movements, rather than specifically by Harlow. At present not enough movements by the town's other makers have been studied to make any firm conclusions.

35. Ernest L. Edwardes, *The Grandfather Clock* (4th ed.), (Altrincham: John Sherrat and Son Ltd, 1980), p. 143.

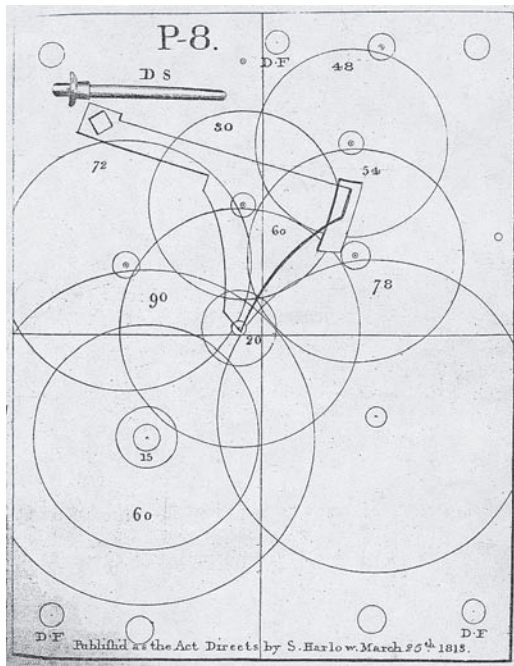


Fig. 21. Front plate layout of a thirty-hour three-wheel ('shake-minute') movement from *The Clock Makers' Guide*.

HARLOW'S THIRTY-HOUR MOVEMENTS

While eight-day Harlow movements have been identified on clocks retailed in places as wide-spread as Sussex and Edinburgh, and many places between, as well as some being exported to America, his thirty-hour movements appear to have been sold more locally in Derbyshire and Nottinghamshire, although examples on clocks from South Wales and Norfolk are known. In 1809 Joshua Bullen, a Norwich merchant, wrote to Peter Stubs 'If you don't make the 30hr forged work for bar frame [i.e. posted-frame] clocks you will not send any as they make no flat frame clocks here'.³⁶ East Anglian clockmakers continued to make posted-frame thirty-hour movements for a while after this, but they were gradually superseded by plated-frame movements, including those supplied by Harlow. Harlow's thirty-hour movements with a three-wheel going train ('shake-minute' movements) are as distinctive as his eight-day ones. Striking was either by means of either a conventional slotted countwheel (with an integral countwheel and gear wheel as

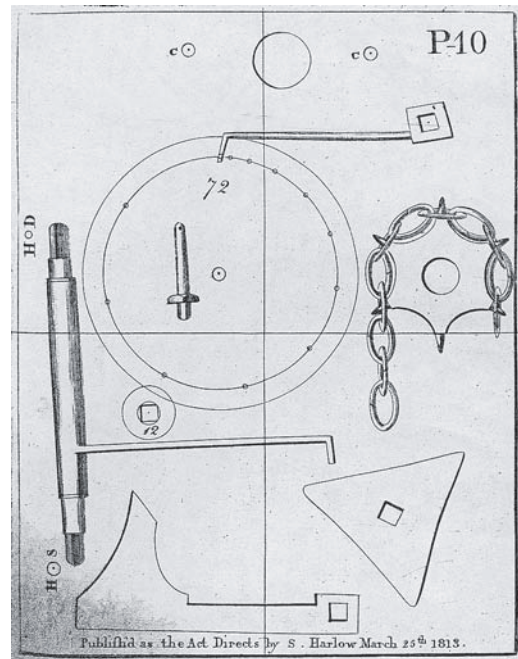


Fig. 22. Back plate of a shake-minute movement with pin-countwheel striking, and some of its components. Note the approximately triangular shape of the lifting piece.

a single casting), or a pin countwheel. The warning piece is pivoted on a stud on the left-hand side (Type 3 striking),³⁷ with the warn flag passing through a slot in the front plate. With a slotted countwheel the link piece to connect the action of the separate warning and locking arbors is external; the link is not necessary with a pin countwheel, as all the strikework is on one arbor. The feature that distinguishes Harlow's design is a brass triangular-shaped lifting piece riveted to the iron warning piece. The bell stand would interfere with the countwheel if it passed through the backcock, as used on eight-day Harlow movements, so it was screwed to the inside of the back plate.

Figures 21 and 22 show engravings of a shake-minute movement from *The Clock Makers' Guide*, with actual movements, having both pin countwheel and slotted countwheel, in Figs 23-26. These movements are distinctly different from other thirty-hour movements made in the nineteenth century.³⁸ No thirty-hour movements attributed to Harlow are known with the names of wholesalers stamped

36. Stubs Papers, Manchester Archives and Local Studies, transcribed by A. A. Treherne.

37. J. A. Robey, *The Longcase Clock Reference Book*, op. cit., p. 237.

38. Ibid, pp. 412-15, 422-5.

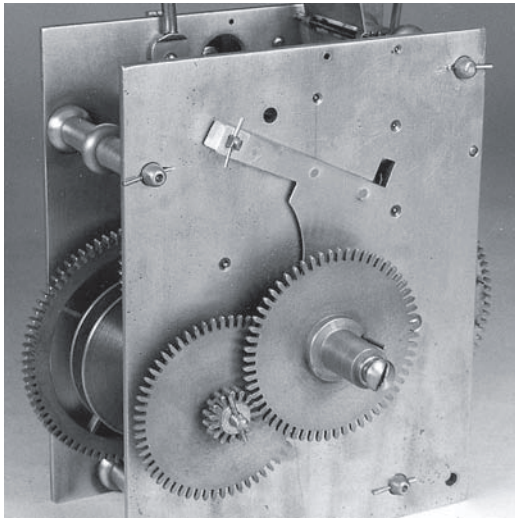


Fig. 23. Front view of a Harlow thirty-hour movement with pin-countwheel striking, fitted with a Wilson round dial about 1800, signed Holliwell & Son, Derby.

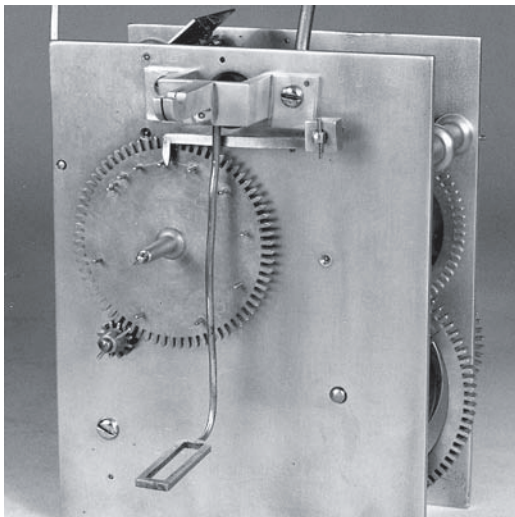


Fig. 24. Pin countwheel of the Harlow/Holliwell movement. The countwheel detent is pivoted on the right.

on them, and it is unlikely that they were exported to America, where, in contrast to England and Wales, thirty-hour clocks invariably used rack striking. Unfortunately, the only early thirty-hour movement seen by the author, fitted with a round brass dial of the 1770s or 1780s signed Samuel Harlow, has had the lifting piece crudely replaced, although it may well have originally been of his distinctive triangular form. This movement has very deeply domed collets (Fig. 27) and the same shape of collets were used on the movement in Figs 23-24. Later movements have collets with the more usual 'top hat' shape, typical of the nineteenth century.

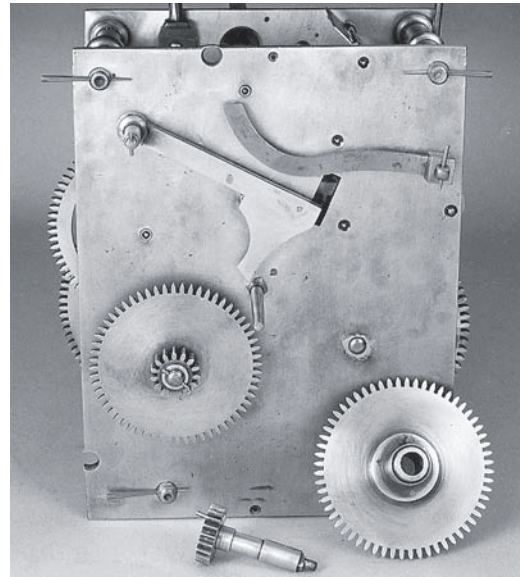


Fig. 25. Thirty-hour movement with a Walker & Hughes, Birmingham, dial signed Hallam, Nottingham. Conventional striking using a slotted countwheel, with an external link piece on the right-hand side. The characteristic brass lifting piece identifies this as a Harlow movement.

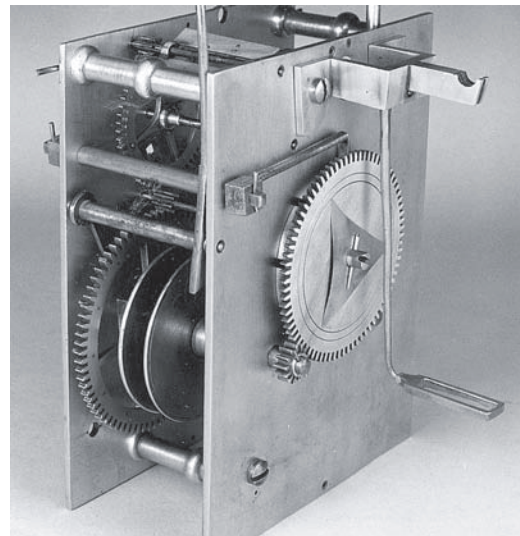


Fig. 26. Integral cast countwheel and gear of the Hallam clock, with the countwheel detent pivoted on the left.

The Clock Makers' Guide also includes engravings of a four-wheel ('centre-pinion') thirty-hour movement (Figs 29-30) of the type favoured in southern England and South Wales, rather than further north. These movements were used to eliminate the large degree of backlash in the minute hand, rather than simply to indicate seconds, as many do not have a seconds hand. Harlow recommended that: 'All

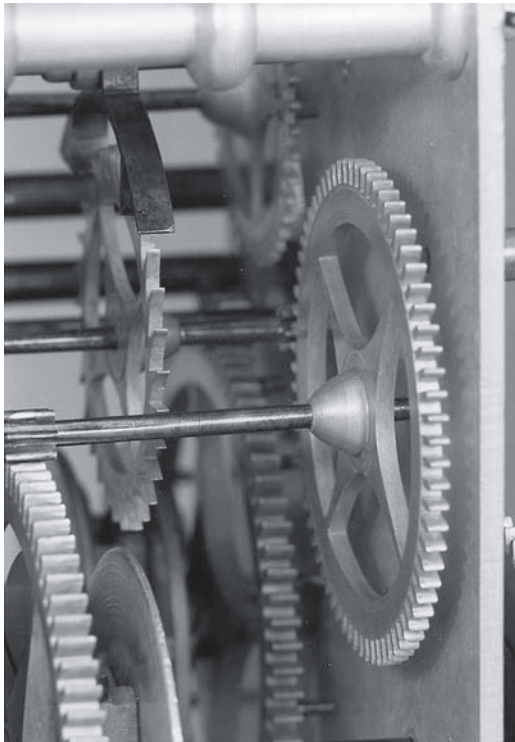


Fig. 27. Deeply domed collets on a thirty-hour clock by Samuel Harlow, about 1780.

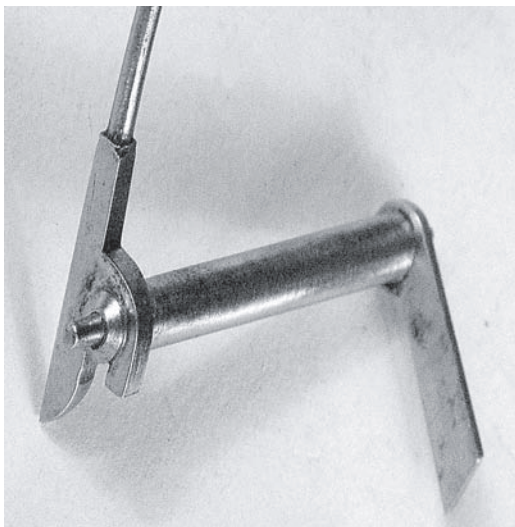


Fig. 28. Attachment of the hammer shaft to its arbor by means of a U-shaped slot, on a Harlow thirty-hour movement with a dial signed by John Brown, Harleston, Norfolk, about 1810. This feature was commonly used on Harlow movements, but was not universal.

thirty-hours centre pinion movements are best made with hoop wheel, and hoop locking, rather than pin locking. The latter necessitates a sloping leading edge to the countwheel slots

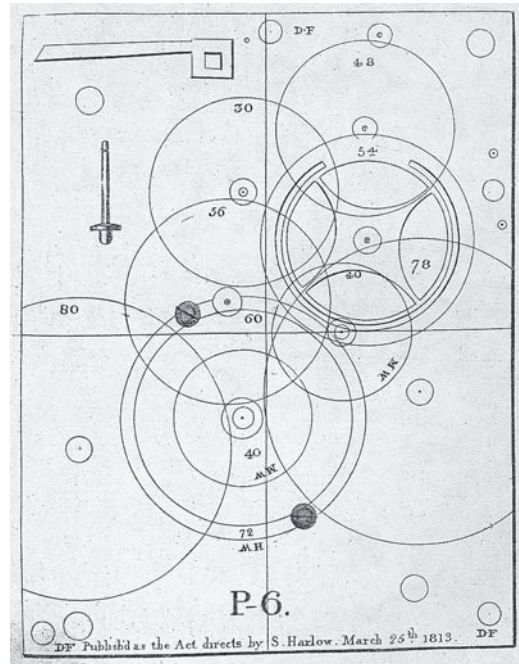


Fig. 29. Wheel layout of a thirty-hour four-wheel going train ('centre pinion') movement, as illustrated in *The Clock Makers' Guide*. Note the straight lifting piece.

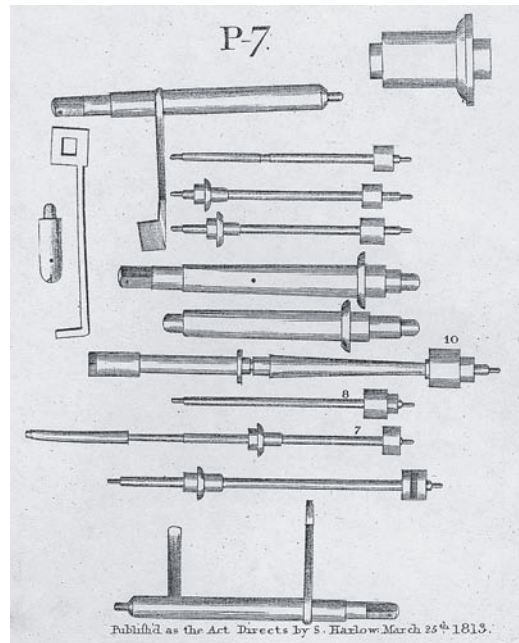


Fig. 30. The arbors for a Harlow centre-pinion movement. Note the internal warn flag (top left) and the locking detent and link piece (bottom).

to assist the locking and countwheel detents to lift at the commencement of the strike.

Harlow's engravings show Type 1a striking with internal warning and link. In contrast with

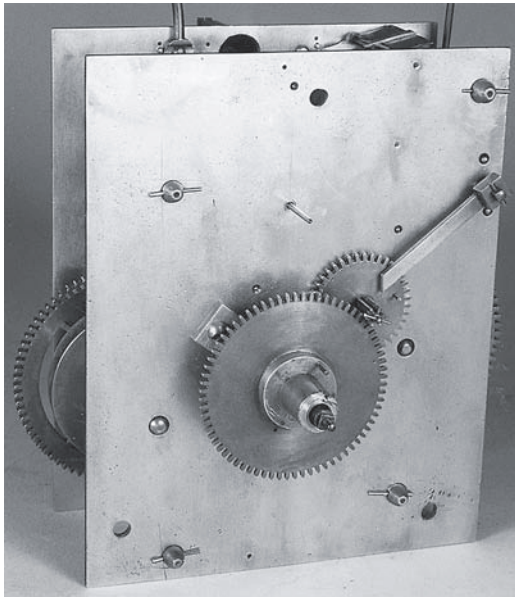


Fig. 31. Four-wheel thirty-hour movement with a Walker & Hughes dial (pendulum dated 1814) signed James Jarred, Devizes, Wiltshire. Very similar to Figs 27-28 and probably a Harlow movement, although there are no unique identifying features.

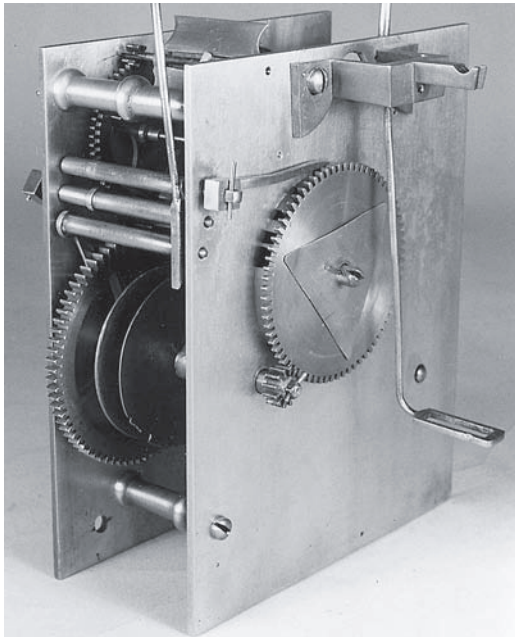


Fig. 32. Rear view of the movement of the Jarred clock.

his other types of movement, Harlow's centre-pinion movements have few distinguishing features, the lifting piece being a simple straight arm. Nevertheless the movement shown in Figs 31-32 appears to be almost identical to that in *The Guide*, and may well have been made by Harlow.

CONCLUSIONS

The Harlow workshop in Ashbourne was a major producer of good quality longcase movements, which were sold to 'clockmakers' throughout Britain and also in America, often via wholesalers in Birmingham and Manchester, and maybe elsewhere. Although the firm was by no means the only such movement manufacturers it is one of the few whose products can be identified, thanks largely to Samuel Harlow's booklet *The Clock Makers' Guide* published in 1813, although its present day rarity indicates that it may not have had a wide circulation among working clockmakers. While it may not have achieved its intended aim of regularizing production, so that painted dials could be fitted with ease to movements from a number of sources, its illustrations have enabled Harlow's movements to be identified, so that his achievements can be now recognized.

A study of these movements has shown that despite coming from the same workshop, each one was individually made by traditional methods, and each one shows detailed differences. This research also emphasizes that a name stamped on a movement is not necessarily that of the actual manufacturer, but is often the wholesaler or retailer. Likewise those who advertised themselves as 'maufacturers' were very often not the actual makers.

Further examples of Harlow's work need to be examined, especially those made early in his career, to determine when his typical design was developed, and to compare them with the work of other contemporary Ashbourne clockmakers. Likewise, it is hoped to study the movements of later Ashbourne clocks, to determine what influence Harlow had on those who followed him.

ACKNOWLEDGEMENTS

Grateful thanks are due to Edmund Davies, Paul Foley (Massachusetts), Adrian Henstock, Brian Loomes, Joseph McKenna, Dennis Moore, Alan Treherne and Trevor Waddington for information and assistance in the preparation of this article. My son Philip has assisted in interpreting information on the Harlow and Masgreave families obtained from the IGI. Illustrations have been provided by B. Loomes (Fig. 6), P. Foley (Figs 8-10), and T. Waddington (Figs 11-12); the remaining photographs are by the author.