THE NOTEBOOK OF HUMPHREY HADLEY OF BIRMINGHAM. PART 1: INTRODUCTION & REPEATING WATCHES

by John A. Robey

MANY clockmakers would have compiled a notebook, known as a calibre or caliper book, when they were trained as an apprentice, and may have continued it later as a journeyman or when working independently, to record useful information, such as wheel trains and layouts, recipes, etc. Unfortunately very few such notebooks have survived.

The notebook of Thomas Walder of Arundel, Sussex, begun in 1788, has been referred to and partially illustrated by Tom Robinson.[1] However, it mainly comprises numerous recipes for various varnishes, stains, gilding, solder, heat treatment of metals, etc. There are some wheel counts for eight-day and thirty-hour longcase clocks, as well as spring clocks, while there are a number of layouts of clock plates, many of them spring wall clocks. The outlines of the plates have been drawn round with a pencil, the positions of the arbors marked, and the wheel and pinion counts recorded, as well as the pendulum length. One is identified as 'By Dutton Lond', a timepiece with an 18in long pendulum, the others being anonymous. They are clearly all from clocks that had been serviced, rather than original designs, and may have been recorded in case a layout was required in the future to suit a particular pendulum size. As there are no formulae or rules of thumb for calculating wheel trains (apart from the sizing of pinions) in his notebook, Thomas Walder, like most clockmakers, would have relied on existing and well-tried layouts, rather than designing his own.

Only ten pages of the 'Calibre Book' of Gawen Brown, dated 1753, survive.[2] He worked as a clockmaker in County Durham, before emigrating to Boston, Massachusetts, USA, by 1749. Of these few pages only half of them contain any horological information, the others include an extract from John Milton's *Paradise Lost*, and a list of biblical references. There is a table of the equation of time, layouts of two thirty-hour longcase clocks, a weight-driven verge timepiece with alarm, two verge watches, and an eight-day longcase clock by Marmaduke Storr of London: 'This Clock went Twelve Years without Cleaning, the weights are 17lb a piece.' Note the practice of using excessive weights to keep a clock running, even in the eighteenth century.

The 'Memorandum Book' of Daniel Burnap of East Windsor, Connecticut, USA, has been transcribed and reprinted, along with his detailed accounts and other documents.[3] Burnap worked for Thomas Harland, who had emigrated to America from England, but was not apprenticed to him as has often been stated. This is one of the most useful contemporary sources of information on eighteenth-century working practices.

THE HADLEY NOTEBOOK

Perhaps the most significant surviving clockmaker's notebook is that attributed to Humphrey Hadley of Birmingham, which covers the period 1690-1746.[4] It comprises two volumes, the second containing only manuscript extracts about spherical projections from *Cursus Mathematicus* by William Leybourne, 1690. The authorship of the first volume, the only one considered here, is not clearly defined, although it appears to have been largely compiled by Humphrey Hadley, with additions by others.

1. T. Robinson, *The Longcase Clock* (Antique Collector's Club, 1981, revised edition 1995), pp. 374-75. This notebook has now been deposited in the Horological Students' Room, The British Museum, London.

2. Gawen Brown's Calibre Book, Massachusetts Historical Society, Boston, MS S-126.

3. Penrose R. Hoopes, *Shop Records of Daniel Burnap, Clockmaker* (Connecticut Historical Society, 1958).

4. Clockmakers' Company, Library, Guildhall Library, MS 6619. There is now a micro-film copy in Birmingham Central Library, Local Studies Department.

There were nine members of the Hadley family working as clockmakers in Birmingham from 1660 to 1863, including four named Humphrey.[5] The most likely to have compiled most of this notebook are Humphrey Hadley II (working 1680-1725), and his son Humphrey Hadley III (born in 1703, and recorded working in 1735-45). Although the Clockmakers' Company catalogue dates the book to 1690-1746,[6] the earliest date seems to be 1693 and the latest 1745. The name 'H. Hadley' appears only once in connection with a diagram for wheel trains, with the comment 'my pich [pitch]', although there are several instances of 'HH', one with the date 2 Sept 1709. While the book does have some entries in a different hand, named items appear to refer to the source of information, rather than the person writing it down, eg 'To make Coper of Iorn. John Mosely Clockmaker' (who appears to be unrecorded). There is an undated manuscript draft for an advertisement for a lost watch by Parkinson of Liverpool (it is not known if this was ever published), with information to be given to William Hadley, plumber, or James Stretch, watchmaker in Birmingham (working from about 1740 and died 1770). The latter was possibly the nephew of Samuel Stretch, clockmaker of Leek, Wolverhampton, Birmingham and Bristol.

As well as horological items the notebook contains a wide range of other subjects, especially a great deal of astronomical information, including astronomical clocks. Miscellaneous topics include a diagram of a 'persan' [Persian] wheel for raising water, widely used in the Middle East, designs for engraving a lock for a pistol or musket, and a sketch (without any text) of a Newcomen atmospheric steam engine. The latter is perhaps not surprising when it is remembered that the first practical steam engine was erected at Dudley, less than ten miles from the centre of Birmingham, in 1712, and was the subject of an engraving published in 1719. The valve gear of this type of engine, with its levers and detents, had many similarities to the striking work of clocks, so no doubt its mechanical features were a talking point with local engineers and clockmakers alike. As might be expected there are recipes for gilding, silvering, etc, as well as designs for clock hands, moon faces, a wind vane and a barometer scale. These pages are certainly from a person or persons educated in mechanics, astronomy and mathematics, and interested in more than their routine clockmaking activities. Longcase clocks by various members of the Hadley family are known, and they made and repaired turret clocks, including repairs to the clock at Lichfield Cathedral in 1745, although no astronomical or other complex clocks are recorded.

Some pages have been damaged and are difficult to read, but the manuscript has recently been conserved and rebound. Also the spelling is very phonetic and idiosyncratic to modern readers, with many variations, such as 'whell' or 'whel' for wheel, 'snel' for snail, and 'stods' for studs. In the extracts in this and subsequent articles, the original manuscript will be presented, as well as a transcription of the text using modern, consistent spelling (including the replacement of the abbreviation 'ye' with its correct form 'the'). Author's additions or comments are in the usual square brackets. In order to facilitate a clearer understanding of the mechanisms described, the diagrams have been redrawn where necessary. It is not practical to reproduce the whole manuscript, rather selected topics will be discussed in a series of occassional articles, starting with some very unusual repeating watches.

HOUR REPEATING WATCHES

One page of the notebook describes two simple repeating watches (Fig 1).

> A Repeating watch without a snail wheel the work
>
> My Cousin Wood's brother-in-law's watch. Oct the 15 1724
> At A is a stud put in one of the 12 teeth of the repeating wheel & that stud stops on the hand wheel catch at A & as the hand wheel goes about the catch goes about and orders the repeating to strike the hours as it goes on every hour one tooth. This stud at A slips over the catch towards B as you wind it backwards & then wind it forwards & then it repeats & strike[s]. Winding it at the square at 12 there is a stud on the catch wheel at e [pin marked, but not identified] & ples [?plies/plays, ie

5. Joseph McKenna, *Clockmakers of Central England* (Mayfield Books, 2002), pp. 8-9 and 200.

6. John Bromley, *The Clockmakers' Library* (Sotheby Parke Bernet Publications, 1977), p. 113.

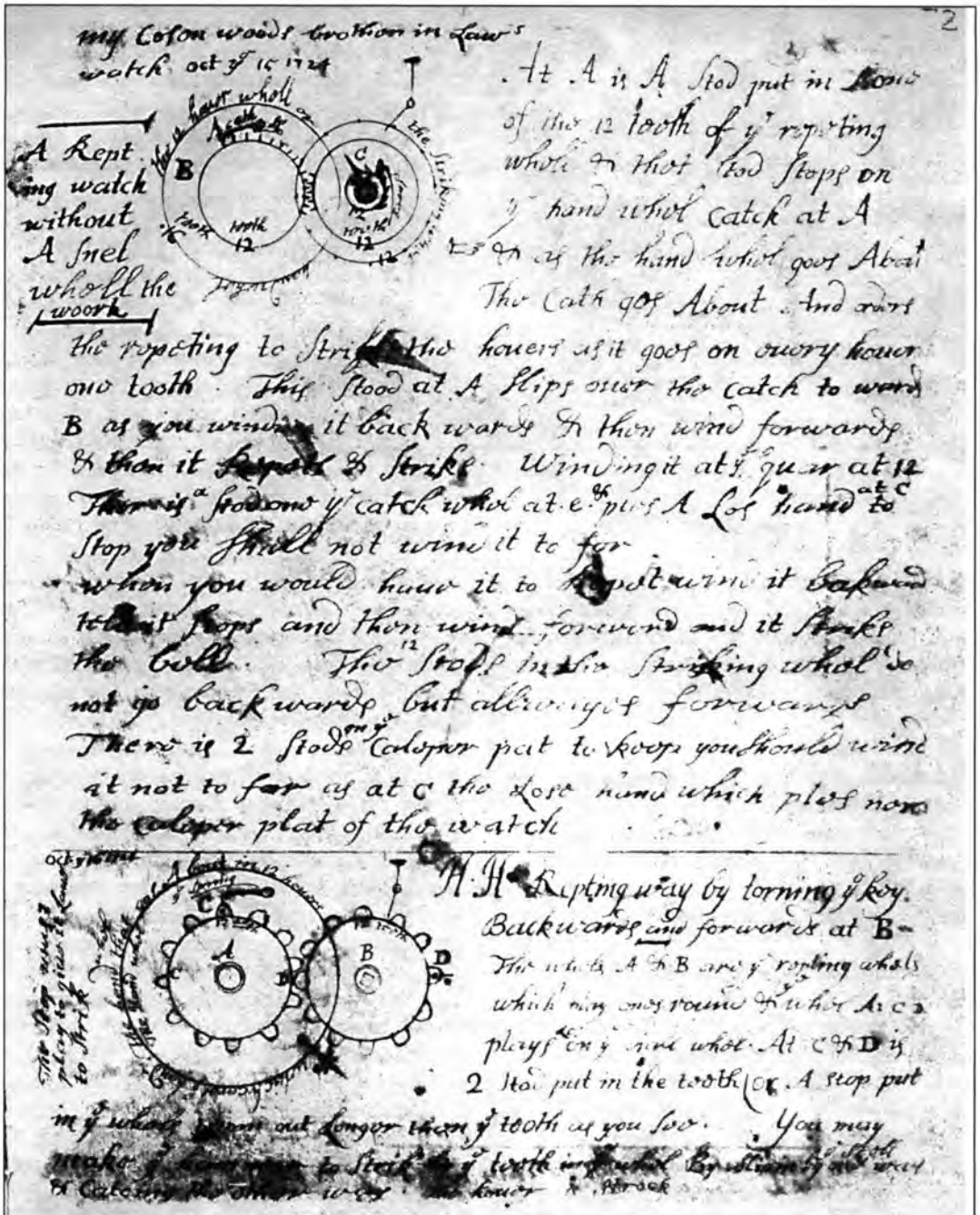

Fig. 1. Description of two simple repeating watches in Hadley's Notebook.

contacts] a loose hand at C to stop you [so you] shall not wind it too far.

When you would have it to repeat wind it backwards till it stops and then wind it forward and it strikes the bell. The 12 studs in the striking wheel do not go backwards but always forwards. There is 2 studs on the caliper plate to keep you should wind it not too far as at C the loose hand which ples ner [? plays near] the caliper plate of the watch. [This presumably should read: There are 2 studs on the caliper plate to keep you from winding it too far ....]

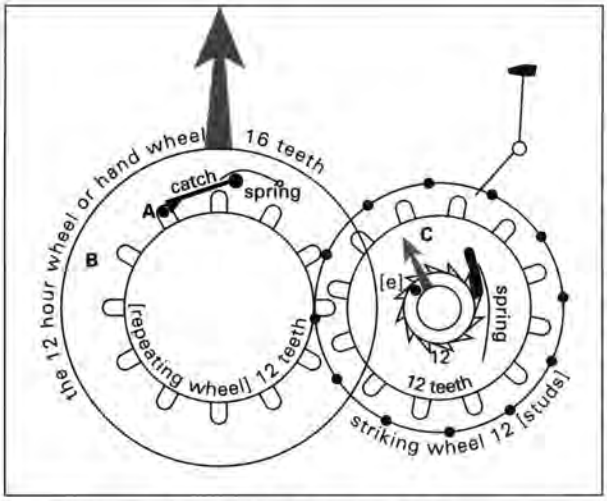

Fig. 2. Diagram of Hadley's first repeating watch.

The redrawn diagram (Fig 2) shows the principles. The first part of the description is largely repeated in the second. The twelve-tooth repeating wheel, with a stud A on a tooth, revolves freely on the same axis as the hour wheel, but is not connected to it. A spring-loaded catch fixed to the hour wheel allows stud A to pass anticlockwise, but engages clockwise to act as a stop. The repeating wheel meshing with another twelve-toothed wheel and rotating on the same axis is a striking wheel with twelve studs or pins round its edge that trip a bell hammer. The latter two wheels are linked by a 'catch wheel' or clickwheel fixed to the striking wheel pipe. A click is attached to the second repeating wheel, so that it can turn anticlockwise without tripping the hammer tail, but when turned clockwise the click engages and rotates the striking wheel to sound the bell. A 'loose hand' C fixed to the second repeating wheel or its pipe can rotate until it is stopped by stud e on the catch wheel.

Rotating C clockwise until it contacts e moves A towards B without sounding the bell. If C is then moved in the reverse direction the striking wheel rotates to strike the hour until A engages with the the catch. Every time this operation is performed A returns to the same starting point to allow A to move the required distance to strike the appropriate number of blows as the hour hand advances. The position of A before this sequence starts does not matter because it is linked to the stop pin e, so that A always turns backwards to the starting position by the same amount. Since the two repeating wheels have the same number of teeth and mesh together, their actual rotational position, due to the operation of the repeat any number of times, is irrelevant.

The description mentions two studs on the movement plate to prevent winding C too far, but they are not shown in the drawing. As C needs to be able to rotate a full circle, it is not clear how the pins could be positioned to achieve their stated aim. It is said that winding is by a 'square at 12', presumably with a watch key, but it would have been more convenient to use C, or an extension to it, maybe on the back of the watch, without having to fiddle with a winding key in the dark.

The reference to 'My Cousin Wood's brother-in-law's watch' implies that it was an actual watch, rather than a proposed design, but no watch working on this principle is known to the author. It is a very simple mechanism, with the limitation of only repeating the last hour. With the teeth of the repeating wheel by necessity being quite wide, the repeat is likely to be not particularly precise near the hour. Also if it is wound backwards before being wound forwards, then an incorrect number of strikes will occur, but if the correct forwards then backwards sequence is followed the repeat sounds correctly. Perhaps it was this potential for confusion that limited its wider use.

On the same page is another design of repeating watch, working on similar principles, written on the following day.

> Oct the 16 1724
> HH['s] Repeating way by turning the key backwards and forwards at B.
> The wheels A & B are the repeating wheel[s] which play once round & wheel A: C D [c and d on the diagram] plays on the hand wheel. At C & D is 2 studs put in the teeth (or a stop put in the wheel & come out longer than the teeth as you see). You may make the hammer to strike by the teeth in the wheel. By sliding by the stud one way and catching the other way the hour [is] struck.

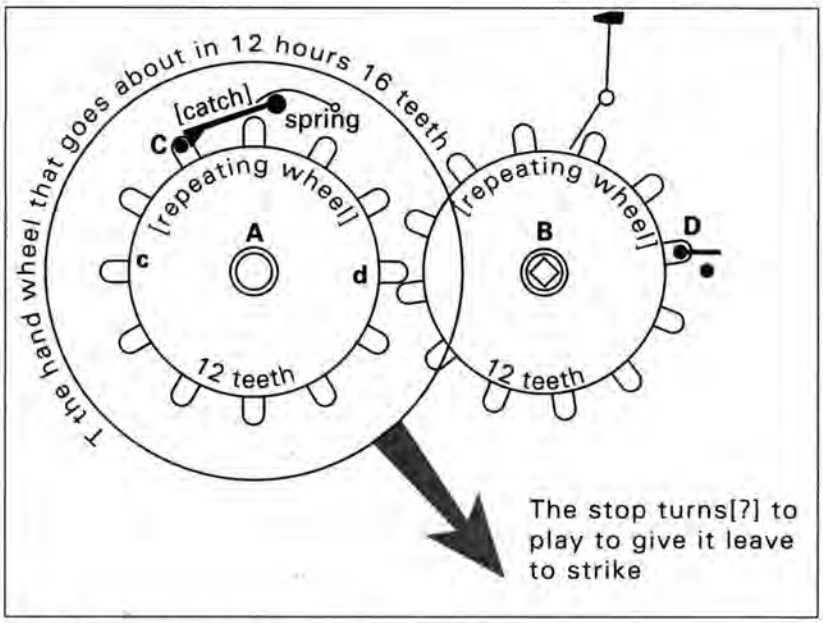

Fig. 3. Diagram of Hadley's second repeating watch.

This watch is an even simpler version of the first one. The twelve-tooth repeating wheel rotating on the hour wheel pipe, the catch and spring (drawn correctly this time), and the second repeating wheel are the same as before. There is no separate striking wheel with pins, and hence no clickwheel or click to allow the square at B to be wound backwards without tripping the hammer tail. Instead there is a small stud or arm pivoted so that it can stop against a pin fixed to the plate when turned clockwise to move the repeating wheels to the starting position, but slips past the pin when rotated anticlockwise to repeat the hour. This pivoted arm is shown fixed to a tooth, but the description says that it is 'put in the wheel & come out longer than the teeth', which is a much more practical arrangement. The teeth of the second repeating wheel trip the hammer tail, instead of a separate striking wheel with twelve pins. As shown these teeth would trip the tail when the second repeating wheel moved in either direction, so presumably the hammer tail had a one-way action to avoid this.

As this watch is described as Humphrey Hadley's 'Repeating way' it may have been a proposed design, rather than a working mechanism. Both this and the following diagram may have been working sketches as he evolved his ideas for a new type of repeating watch.

The next page has a further design of repeating watch (Fig. 4, see following page), but the top part of the page is missing.

> ... the finger at B must ply between the 2 studs at B & A. When plucked the finger at B must slip over the stud at B as it goes round backward. The hammer stel [tail?] must catch one way and slip by the other way.
> So the striking wheel go backwards & forwards you may have a string & nat [knot] or spring to pluck it back.
> The striking wheel must play less on the dial wheel.
> The stud[?] at the hand catches one way & slips over the other way the finger at B.

This design of repeating watch is a variant on the previous two, with the separate meshing repeating wheels replaced by a single striking wheel with twelve pins, placed concentrically with the hand wheel. The mode of operation (Fig. 5) is less obvious than the previous examples, but it would be more convenient to use as it involved just pulling a cord to set the mechanism and then allowing a spring (mentioned but not shown) to reverse the rotation and sound the hours. Confusingly there are two items marked B. Also there are two sections of teeth on the hand wheel that are of

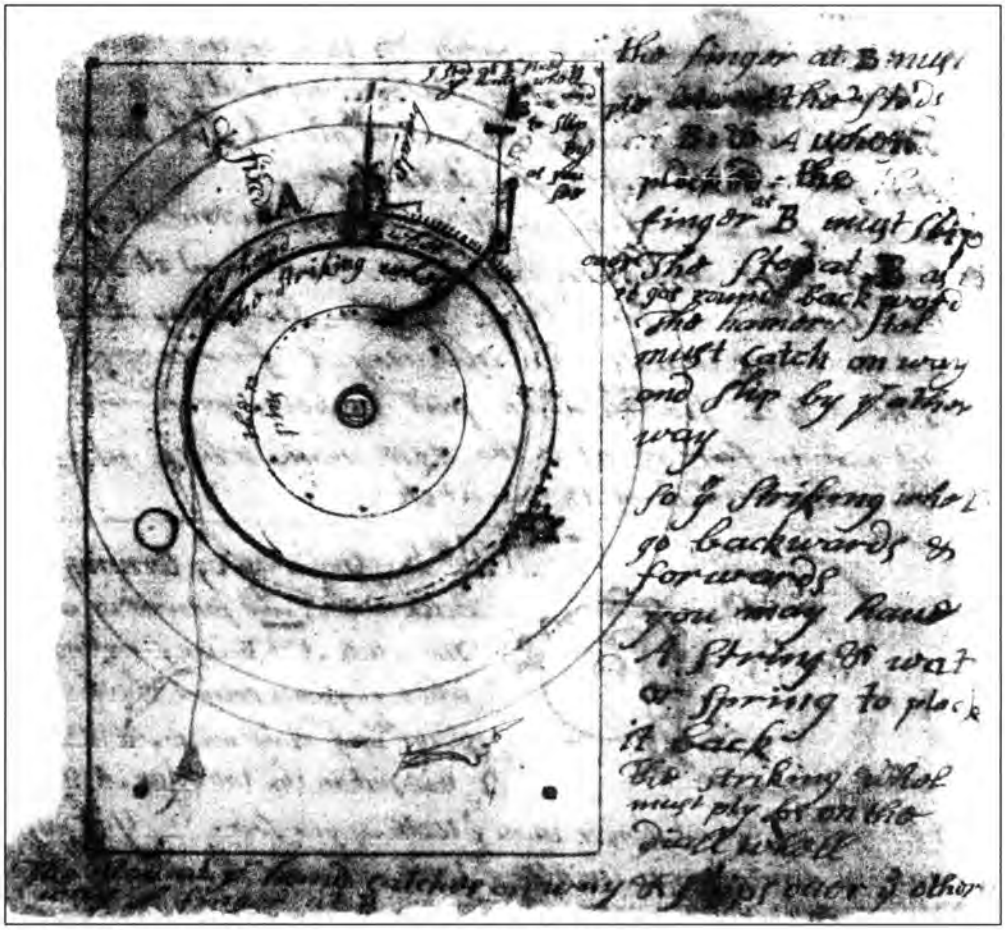

Fig. 4. Description of another repeating watch in Hadley's Notebook.

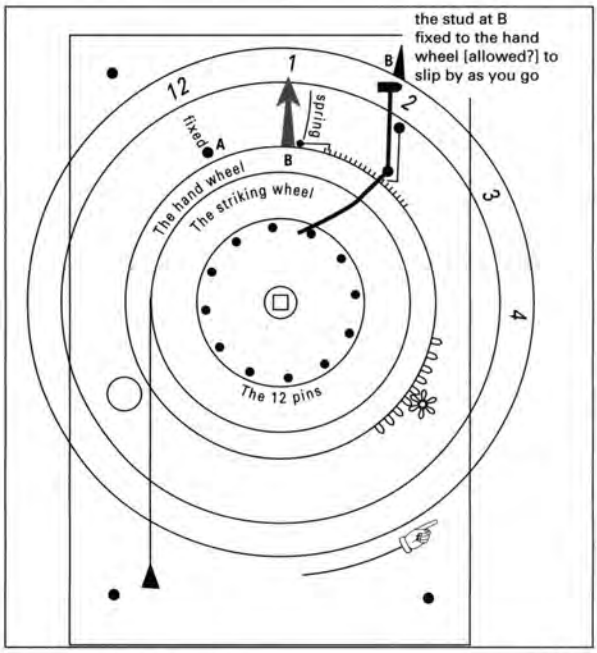

Fig. 5 (left). Diagram of Hadley's other design of a repeating watch.

different size and pitch. Are these meant to represent the teeth on a separate coaxial wheel? The diagram is confusing and the exact mode of operation is not obvious.

ACKNOWLEDGEMENTS

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