

Time's Wheels In Motion

By Nigel Raffety



*What is the time?
The shadow on the dial,
the striking of the clock,
the running of the sand,
day and night,
summer and winter,
months, years, centuries -
these are but arbitrary and outward signs,
the measure of Time, not Time itself.
Time is of the soul.*

Longfellow, Hyperion Book ii Chapter 6

Figure 1.
Engraving by Johannes
Stradanus depicting
the interior of a
clockmaker's
workshop.

Early civilisations had resorted to measuring time either by the sundial, which relied upon the moving shadow caused by the sun's rays or a *clepsydra*, which was a water-clock. This worked by the liquid dripping through a small aperture and hours being registered by the level of the water in the calibrated receiving vessel. The Romans divided their daily life into three-hourly intervals and these periods became the basis of the canonical hours of the Christian Church. In the seventh century, Pope Sabinianus decreed that the monastery bells should be rung seven times, day and night, to announce these segments of the religious day.

The urgent need to sound these hours accurately, focussed men's minds on how to improve upon the poor timekeeping provided by both the sundial and *clepsydra*. The answer appears to have come in the latter part of the thirteenth century with the invention of the weight driven mechanical escapement clock, probably in Western Europe or possibly in England.

These clocks were placed *inside* cathedrals, monasteries and abbeys. Many of them carried elaborate astronomical indications as well. The archives of St. Paul's Cathedral, London, reveal that Bartholomew the Clockmaker (*Orologario*) was working on the clock there in 1286 and that upon completion of his labours, this account was to be paid in the form of 'twenty three bowls of beer'. There is however no mention over what period of time this was settled! ¹

Later, these clocks were placed in the Church tower, or belfry, and became known as *turret clocks*, and sounded each hour on a bell to regulate the timekeeping of the local community. These clocks were probably an Italian invention and the first of these is believed to have been installed in the Church of San Gottardo in Milan in 1335. The first turret clock in England was that installed by Edward III in Windsor Castle at 1352. This clock was likely to have been made in Italy and was delivered by three Lombardy clockmakers who brought the mechanism up the Thames from London to Windsor, at a cost of one shilling and six pence. Before long these iron framed clocks were fitted to most church towers and important buildings throughout Renaissance Europe. Being of iron framed construction, weight driven and of fairly crude construction, they were made by craftsmen possessing skills primarily associated with those of a blacksmith.

In 1540, it is recorded in the archives of St. Andrew Hubbard Church in the City of London that Bryce Austen, Clockmaker to King Henry VIII of England, entered into an agreement to repair and maintain the church clock. Austen could not write so he signed the document with his mark, a crude drawing of a crank key for winding a clock. Despite Austen's grand and enviable title, it is unlikely he was able to make a clock since domestic timepieces were few and far



Figure 2. German hexagonal table clock by Zoller of Augsburg, circa 1590.

between in England.

The King would have to cast his eye further afield to Continental Europe, particularly France and the German clock-making towns of Augsburg and Nuremberg. These areas were producing elaborate clocks, watches and scientific instruments at this early date, most of which can only be termed marvels and truly termed works of art. The German hexagonal table clock by Matinus Zoller, was made in Augsburg about 1590 and shows the fine gilt and engraved case. The silver and red enameled dial indicates the phase of the moon, lunar day, date and year calendar. (fig. 2)

King Henry VIII's liking and enthusiasm for small clocks, and indeed watches, is well documented and it is known there were many such items in the Wardrobe Inventories of the period. As well as those clocks that were made for his own use, many were given as gifts to his friends and favourites as well as visiting dignitaries and foreign diplomats. Many transactions by the King are recorded in the privy purse expenses from November 1529 to December 1532 and it is noteworthy that these purchases were mainly from Frenchmen. Many different craftsmen contributed to making these exquisite baubles. Chasing, engraving, enamelling, gilding and the use of silver and gold all played a very important part in the production of these very individual pieces, highly prized by their owners and quite the status symbol of their day.

Of particular interest, and a case in point, is the splendid clock given by King Henry VIII to Anne Boleyn upon their marriage in 1533. The case bears the engraved Royal Coat of Arms and both the driving weights are engraved with Henry's



Figure 3. French ivory and painted sundial, dated 1565.

and Anne's initials, together with a true lover's knot. It is presently in the Royal Library at Windsor Castle. The Royal clockmaker at this time was Nicholas Oursian, a Frenchman.

The sundial was still popular and very much in use as a portable daytime timekeeper. The small French ivory string-gnomon diptych sundial (fig. 3), has silver catches and clasps and is extremely rare in that the inner top lid it is painted with a landscape scene and a coat of arms, probably those of the Savron family of Provence, and the style is reminiscent of book miniatures of the period, even perhaps painted by the same artists.

The wonderful South German chamber or wall clock shown (fig. 4) dates from about 1620. The case retains much of its original polychrome decoration and the weight-driven movement strikes each hour and quarter hour on the bells above. It is also worth noting that both this clock, the table clock in figure 2 and many timepieces made up to the present day, incorporate indication of the phases of the moon - a most important feature to show on a timepiece in the days when there was of little or no street lighting, particularly in rural areas. Those planning a night journey, or even a social occasion for an evening, would plan their dates upon the availability of moonlight.

Towards the end of the sixteenth century, the clock-making industry in England altered dramatically with the



Figure 4. South German painted iron chamber clock, circa 1620.

significant influx of largely Huguenot craftsmen fleeing religious persecution in Continental Europe.

Nicholas Vallin, who was of Flemish origin, came to England for

this reason. He produced a

number of clocks, half a dozen or so are known to have survived. The most important is his superb large iron chamber clock, signed and dated 1598, which in addition to hour striking also plays each quarter hour on a carillon of thirteen bells. This can be seen in the British Museum, London. ²

The early part of the seventeenth century saw the numbers of refugee craftsmen swell so much that jealousies and dissensions arose concerning these "*clockmakers strangers from beyond the Seas*". Things went from bad to worse until, in 1630, the established clockmakers, many of whom were unsuccessful in joining the Blacksmiths' Company earlier, petitioned the King to establish their own Company within the City to regulate their own craft. This was achieved a year later and a Royal Charter was granted on 22nd August 1631.

The lantern clock became the first English domestic clock to be produced at this period. The example illustrated by



Figure 5. English lantern clock by William Allman, dated 1637.

William Allman, London, (fig. 5), shows the classic style characterised by square top and bottom plates surmounted by the large hour bell. It has four turned corner pillars and finials and a thirty hour movement with one weight, or more if fitted with hour striking or alarm work. These driving weights hang freely below the clock case. The origin of this clock's name is a mystery, although it does resemble a lantern in its shape. Brass, the main metal of which lantern clocks are made, is an alloy of copper and such alloys are often called latten, hence 'Lantern' could be a corruption of this word.

Following the Incorporation of the Clockmakers' Company, in 1631, London strengthened its predominance as the centre of British clock-making and lantern clocks began to be made in provincial towns. The new Company's ordinances showed that other than the Clockmakers, their ranks included a diversity of membership within the Company such as mathematical instrument makers, gravers, case-makers and sundial makers. The inclusion of the last category



Figure 6. Ebony architectural table clock by Henry Jones, London.

amongst the specialist craftsmen may at first appear surprising but, despite the many technical advances made to clock-making, both weight driven and spring clocks were dismal timekeepers and the use of the sundial was essential to set them accurately to time on a daily basis.

By the middle of the seventeenth century, it was clear that accurate clocks were needed for two main reasons. Firstly, to allow astronomers to make accurate observations of the planetary motions and secondly, to enable the determination of longitude at sea to improve the navigation of the world's fleets. However, the situation was all about to change dramatically for the better with the introduction of the *pendulum* as the regulator of the running down of the clock spring or weight.

Although in Italy there are drawings known³, which date from the early seventeenth century that show the concept of the pendulum, it was the famous astronomer, Galileo Galilei, (1564-1642) who, upon a visit to the cathedral in Pisa in 1581, discovered the isochronous property of the pendulum. He was able to observe there that the swing or vibration of the chandeliers were of equal duration. Later, Galileo devised a form of escapement coupled with a pendulum and his son, Vincenzo, who died in 1649, is reported to have made a clock which is described in the Will as 'an iron clock unfir-

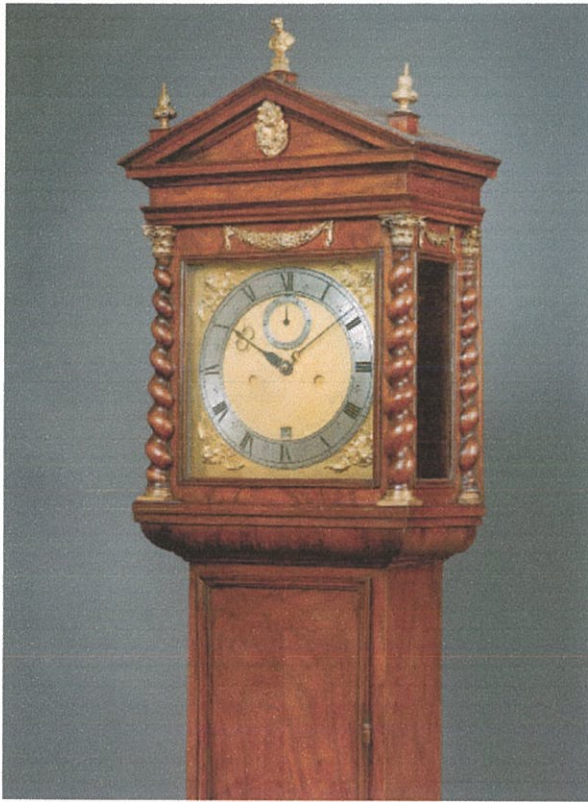


Figure 7. Walnut architectural longcase by Henry Jones, London, with seconds pendulum.

ished, with pendulum, the first invention of Galileo'.⁴

The great Dutch scientist, Christiaan Huygens, (1629-1695), claimed on Christmas Day, 1656, that he had made the first model of a pendulum clock. As his ideas developed, Huygens employed the clockmaker Salomon Coster, working in the Hague, to make the first pendulum clock for domestic use. News of the new invention spread quickly and, in 1657, the London clockmaker Ahaseurus Fromanteel sent his son, John, to work in Coster's workshop to learn about the making of these new pendulum clocks. The following year, Fromanteel made his now famous announcement in the *Mercurius Politicus* on October 28th 1658:

There is lately a way found out for making of clocks that go exact and keep equaller time than any now made.....Made by Ahaseurus Fromanteel,who made the first that were in England: you may have them at his house on the Bankside in *Mosses Alley, Southwark* and at the sign of them *Maremaid in Louthbury*,...

The introduction of the pendulum heralded the start of the 'Golden Age of English Clockmaking' which was to last for some 150 years. Even more extraordinary was the coincidence of this invention with the Restoration of the monarch, King Charles II, in 1660. This was after England had undergone eleven years of Puritan republican rule following the Civil

War. John Evelyn, the diarist, described this time 'a politer way of living, which passed to luxury and intolerable expense.'⁵

Initially, the Fromanteels produced pendulum clocks with similar style cases to those of Coster. The cases were of very plain wooden box construction and the movements had velvet covered dials which hinged the movement out towards the front. Soon the style became more English, the ebony veneered cases were made in the architectural style and embellished with restrained gilt mounts and finials. Indeed, the basic design the Fromanteels established at this time, for both their cases and movements of table and longcase clocks, continued throughout the duration of the Golden Age to the end of the eighteenth century and beyond.

The fact that these architectural clock cases exhibit such perfect proportions makes one believe their design must have been inspired by the work of the most eminent architects of the time, enthralled by the Renaissance style. Immediately we think of Sir Christopher Wren and his churches soon to glory London and perhaps Sir Roger Pratt, another fashionable architect of the day.

The Fromanteels were, however, not the only early makers of pendulum clocks in London. Edward East held the position of clockmaker to King Charles II from 1660 and Henry Jones had been apprenticed to him earlier. Figure 6 shows a fine ebony veneered table clock by Jones, with short pendulum verge escapement. This case is typical of this early period, showing the severe ebony veneered moulded case with architectural pediment and contrasting restrained gilt dial with slender chapter-ring.

Figure 7 illustrates a superb longcase clock by Henry Jones, London. The case is again of elegant architectural form and veneered in walnut on an oak carcass. The hood is enriched with superb quality gilt swag mounts and cappings to the barley twist columns. This clock houses the next ground breaking development of superior timekeeping, the long pendulum. This pendulum, which is a little over 39 inches in length, together with the anchor escapement, brought about true precision and clocks with this sophistication were now able to keep time within *seconds* a week!

The seconds pendulum, as this is called, was introduced in the late 1660's. It is not known who actually invented this long pendulum but the longcase clock made by William Clement of London in 1668 must be one of the earliest longcase clocks to incorporate this development that can only be likened to the invention of the computer chip technology of today. The case is somewhat similar in design to the Henry Jones example (fig. 7), but veneered in ebony with contrasting gilt mounts to the hood.

The Charles II ebony miniature longcase by Anthony

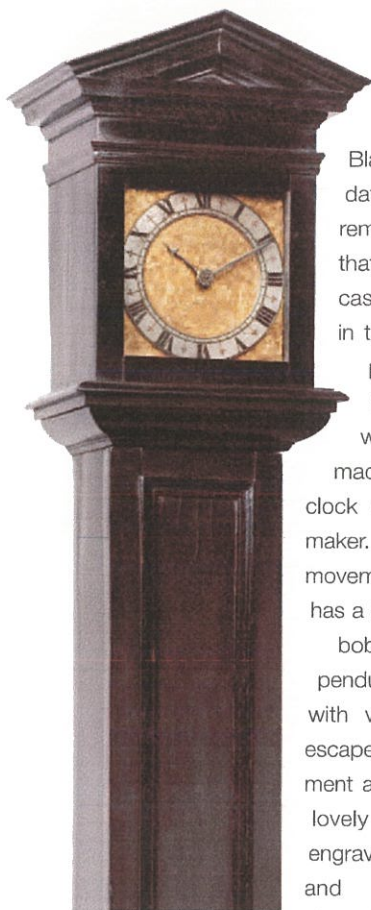


Figure 8 and detail below. Miniature ebony timepiece with gilt dial, circa 1670.

Blackford of Warwick, (fig. 8), dates from about 1670 and is so remarkable in several respects that it is possibly unique. The case is ebony veneered on oak in the traditional manner for the period but is of such unusually slender proportions and would probably have been made in London by a leading clock case maker. The movement has a short bob pendulum with verge escapement and a lovely gilt engraved and dial, signed by



the clockmaker. This remarkable clock only came to light last year after having been in the same family for many generations, even possibly since it was originally made!

The Library Company of Philadelphia has amongst its interesting collection of clocks,⁹ a walnut veneered tallcase clock by John Fromanteel that was bequeathed to the Company in 1796 by William Hudson. The case seems to be typical of the earlier style of those previously mentioned but also has a good scroll cresting at the top of the hood.

The Great Fire of London in 1666 caused an unexpected further stimulus to clock-making and to the luxury trade in general, driven by rebuilding and refurbishing a great number of merchants' houses. There was also a greatly increased interest in science and King Charles II was a great patron of the Arts. The Royal Society was established in 1662 and this was the time of Sir Isaac Newton, whose research is universally recognised as having laid the basis of modern science.

In 1670, Joseph Knibb came to London from Oxford and established a flourishing business. A fine example of a typically elegant longcase clock by this maker is shown in (fig. 9) This month duration clock was made for the Duke of Hamilton of Scotland who was created Hereditary Keeper of the Palace of Holyrood in 1646 by Charles I. The Hamilton archives

record that the Duke bought clocks directly from Knibb on a visit to London in 1679. It is quite reasonable to speculate that this clock was one of those ordered in that year. Knibb had earlier supplied three clocks to St Andrews University in Scotland. His reputation had by now spread far and wide, as confirmed by the following account, he is now 'famous' and had sold out of stock!

Interestingly, in 1675 another visit is recorded to Knibb's workshop by Sir Richard Legh of Lyme Hall, Cheshire, in a letter to his wife as follows:

...thy I went to the famous pendulum maker Knibb, and have agreed to buy for one, he having none ready but one dull stager which was at nineteen pounds; for five pounds more I have agreed for one

finer than my Father's, and it is better finished with carved capitalls gold, and gold pedestals with figures of boys and cherubines all brass gilt. I wold have itt Olive Wood (the case I mean) but gold does not agree with that colour, soe took their advice to have it black Ebony which suits your cabinet better Walnutt tree wood, of which they are mostly made. Let me have advice herein by the next.

His wife's reply was a meek and mild but sound, observation:

My dearest Soule; as for the Pandolome case, I think Blacke suits everything

A year after Joseph Knibb's arrival, Thomas Tompion came to London and set up shop in Water Lane, on the south side of Fleet Street and was later admitted to the Clockmakers' Company (*sic*) in September of that year. He was later known as the 'Father of English Clock-making'. He became great friends with Robert Hooke (1635-1703), who was Curator of Experiments for the Royal Society (*sic*) and introduced Tompion to Hooke's distinguished scientific colleagues, the King and the nobility; the base from which an extensive wealthy clientele was established. Tompion made a watch for the King with a balance spring in 1675 and a year later two magnificent year-going clocks with thirteen foot pendulums for the new Royal Observatory at Greenwich. Establishing a workshop of some twenty people, he made some 700 clocks and over 5000 watches, many of which are numbered, and all, without exception, of the highest quality, craftsmanship, and exhibiting the greatest ingenuity.

The Metropolitan Museum of Art in New York has in its horological collection an early and exceptional example of a Tompion longcase, dating from about 1675-78. It shows both the quality of the casemaking and clockmaking associated with this maker. The case is veneered with oyster olivewood

Figure 9. Walnut month-going longcase by Joseph Knibb, London, circa 1679.



and inlaid with marquetry panels and leaves of green stained bone. The movement has a very individual dial layout and shows the phases of the moon's age (*sic*), high tide at London Bridge, full calendar and strikes in an unusually complicated way.

A magnificent walnut and ormolu-mounted longcase is shown in (fig. 10), and has become known as the 'Record' Tompion, probably as a result of the supposedly high prices paid for it over the years. The clock runs for three months at each winding and has the rare feature within Tompion's known work of a perpetual calendar, which accounts for Leap Year. Again the quality of the case and movement is extraordinary.

This clock was originally made for King William III's bed-chamber at Hampton Court Palace in England. Years later Queen Victoria gave the clock to her cousin, the second Duke of Cambridge. Upon his death in 1904, the clock was sold at Christie's auctioneers in London, and eventually joined the famous Wetherfield collection, which was broken up upon Wetherfield's death in 1928. The American collector, Francis P. Garvan, subsequently purchased the clock for £5000 and it was for several years at the Pennsylvania Museum. The clock subsequently returned to England in 1934 and joined

Figure 10. The 'Record' Tompion.





Figure 11. Ebony striking bracket clock by Daniel Quare, London, circa 1700.

the collection of J S Sykes, where it remained until 1955. The clock then made its second voyage to America, having been sold for £11,000 to Colonel Williamsburg in Virginia. It is their pride and joy been wonderfully conserved and stands resplendent as ever in the Masterworks Gallery of the DeWitt Wallace Decorative Arts Museum.

Daniel Quare was admitted to the Clockmakers' Company in the same year as Thomas Tompion, 1671. He came from Quaker stock and consequently he was not prepared to swear an oath. Thus when he took his first apprentice in 1673, the apprentice was described as a 'covenant servant'. His business grew very substantially over the years and again because of his Quaker belief he would not swear an oath to King George I in order to become the Royal Clockmaker. Quare obviously had incredible talent and ability and George I compromised and gave him access to the palaces 'by the back stair'. He said 'the Yeomen of the Guard, lets me frequently go up without calling anybody for leave, as otherwise he would tho' persons of quality'. Quare's achievements are considerable and he made a significant number of high

Figure 12. Queen Anne walnut portable barometer by Daniel Quare, London.





Figure 13. Queen Anne walnut month longcase clock by Daniel Quare, London.

quality watches, longcase and bracket clocks. In his will he left seven thousand pounds in cash in 1724.

Figure 11 shows a fine ebony and gilt- mounted bracket clock which is beautifully signed on the dial and back-plate. The case with scroll carrying handle is so typical of this maker.

In 1695, Quare invented a portable barometer ⁷ that could be '*turned upside down without spoiling the quicksilver*'. He applied for a Patent which was granted by James II despite the opposition of the Clockmakers' Company.⁸ Figure 12 illustrates a typically fine walnut example with barley-twist and fluted stem, the head bearing Quare's signature and the number 34, stamped to one side. Quare quite often numbered his barometers but rarely his clocks. It was only when he entered into partnership with Stephen Horseman that the clocks generally were numbered.

The month-going longcase by Quare shown in figure 13 has a very beautiful walnut case with ogee caddy top. The figured veneers to the trunk door are 'book matched' and the complete case retains the original colour and patina, so beloved by collectors of period furniture world-wide. This clock is on display as part of the Rienzi Collection, at the Museum of Fine Arts, Houston. Figure 14 shows a rare walnut 'grandmother clock' by the well known and exceptional clockmaker, Christopher Gould of London. The small gilt and signed dial is engraved Suona / Non Suona for the strike/silent option. It is interesting as it was made for the Italian export market and confirmation of its import is supported by the old, Italian customs stamp visible within the case. This clock was probably intended to be placed in a bedroom as the movement has a silent escapement to soften the tick of the clock and a pull repeat on five bells which can be activated to indicate the time at night. The clock is only 72 inches tall including the gilt brass finials.

George Graham, or 'Honest George' as he became known, is another great horological name who became a journeyman to Thomas Tompion from about 1696, married Tompion's niece and became a business partner to Tompion, eventually succeeding to the business in 1713 upon Tompion's death. He was buried in Westminster. Graham's work is characterised for its clear simplicity and functionality. His main accomplishments were the invention of the dead-beat escapement and the mercury filled pendulum which revolutionised further accuracy in clocks. He assisted John Harrison with his lifelong quest to produce a sufficiently accurate sea clock, or chronometer, to determine longitude and win the substantial prize of twenty thousand pounds, offered by Queen Anne.



Figure 14. Walnut 'grandmother' longcase clock by Christopher Gould, London, circa 1700.



Figure 15. Ebony and gilt striking bracket clock by George Graham, London

In 1492, Christopher Columbus discovered the New World by good seamanship and a good degree of guesswork. The marine chronometer was first successfully developed late in the eighteenth century and remained unchallenged until the introduction of electronic and satellite communication systems. (Refer to Bibliography for the story of Longitude, told so well by Dava Sobel).

Graham continued the series of numbering of all his clocks and watches when he took over the business on Tompion's death, in 1713. Considerable research has been undertaken into dating Tompion's and Graham's work, the foundations of which are based upon dated receipts or invoices. Number 681, for instance, retains its original invoice dated 1728 and bears Graham's signature.

Figure 15 shows a fine ebony and gilt-mounted striking bracket clock by this maker, both the dial and finely engraved backplate bearing his signature. It is numbered and dates the clock to about 1740.

Whilst most clocks and watches are signed by the maker's

Figure 16 opposite. Detail of dial of Beyer astronomical longcase, dated 1718.





Figure 17. George II tavern clock by David Compigne, Winchester, circa 1735.

name and there are plenty of further detailed records available in England from the Clockmaker's Company since its incorporation in 1637, it is unfortunate that so few longcase and bracket clock cases are signed or bear a trade label of any kind. Also, it is a rarity to find a clock movement dated as well as signed. Recent research has revealed that Tompion sub-let part of his property in 1677 to Jasper Braem of Dutch extraction. He was probably responsible for a number of the the fine marquetrie longcase cases made for Tompion during the 1670's-1680's.

Figure 16 illustrates the dial of an exceptional George I period astronomical longcase clock by William Beyer of London and it unusually, bears the date 1718. The imposing ebony case

has a fretted caddy-top and capped corner-columns. The beautiful dial with painted decoration in the background shows the phases of the moon, high tides, length of daytime light and has a perpetual calendar with a rare fly-back date in the arch.

'Act of Parliament' or Tavern clocks are amongst the most interesting and individual of all wall clocks because of their huge historic and decorative appeal. For years they were mistakenly termed "Act of Parliament" clocks on the grounds that in 1797 Pitt the Younger introduced a tax by Act of Parliament whereby:

For and upon every clock or timekeeper by whatever name the same shall be called.....shall be charged an annual duty of Five Shillings.

It was suggested that these large clocks were put in taverns and other public places for the benefit of those no longer able to afford a watch or clock of their own. The Act was repealed a year later in 1798 after intense lobbying by the clockmakers who had seen their businesses suffer and sales plummet.

Figure 17 illustrates a very original mid eighteenth century black lacquer and gilt chinoiserie tavern clock by David Compigne, Winchester, with shield dial and weight driven movement and elaborately pierced brass hands.

Tavern clocks were in fact made from about 1720 until the early years of the nineteenth century. With their early, clearly



Figure 18. 18th century interior of a horological workshop.

legible dials and bold hands they were ideal timekeepers for inns and coaching houses that prided themselves on keeping strict schedules for their coaches that brought them so plentiful a trade. The weight driven movements kept excellent time and being placed high on the wall they were safe from the more boisterous or inebriated clients. It is occasionally possible to see these clocks in old coaching inns today.

Notes

1. British Museum Cart; Cotton XXI. 24
2. A.W.J.G. Ord-Hume, *The Musical Clock*, Mayfield 1995 pp 64-66
3. G.H. Baillie, *watches*, London 1929, p.32, quoting from *Fiamma's Chronicles*
4. La Clesidra, Rome, illustrations for *L'Orologio e il pendolo*, Morpurgo pp2,4,29
5. *Evolution of Clockwork*, Drummond Robertson, Chap VI. Cassell, London 1931
6. Jay Robert Stiefel, *The Library Company of Philadelphia*, *The Magazine Antiques*, August 2006, pp 88-93
7. Nicholas Goodison, *English Barometers 1680-1860* (Antique Collectors' Club 1977 pp. 206-221).
8. Daniel Quare Barometer Patent, *The Bodleian Library*, University of Oxford, Ms rawl. A241 fols. 90 r + v. 91r

Bibliography

- George White, *English Lantern Clocks*, Antique Collectors' Club 1989
- Hans van den Ende, Dr Frits van Kersen, Maria F. van Kersen-Halbertsma, Dr John C. Taylor & Neil R. Taylor, *Huygens' Legacy, The Golden Age of the Pendulum Clock*, Fromanteel Ltd 2004
- Percy G. Dawson, C.B. Drover & D.W. Parkes, *Early English Clocks*, Antique Collectors' Club 1982
- Jeremy Evans, *Thomas Tompion at the Dial and Three Crowns*, The Antiquarian Horological Society 2006
- Ronald A. Lee, *The Knibb Family – Clockmakers or Automatopaei Knibb Familiae*, The Manor House Press 1964
- R.W. Symonds, *Thomas Tompion, His Life and Work*, B.T. Batsford Ltd 1951
- Katherine S. Howe et al, *Rienzi European Decorative Arts and Paintings*, Scala Publishers in association with The Museum of Fine Arts, Houston 2008
- Eric Bruton, *The Weatherfield Collection of Clocks, A Guide to Dating English Antique Clocks*, N.A.G. Press Ltd 1981
- Cedric Jagger, *Royal Clocks, The British Monarchy and its Timekeepers 1300-1900*, Robert Hale Ltd 1983
- Nicholas Goodison, *English Barometers 1680-1860*, Antique Collectors' Club 1977
- Ronald E. Rose, *English Dial Clocks*, Antique Collectors' Club 2000
- Dava Sobel, *Longitude*, Fourth Estate Ltd 1996