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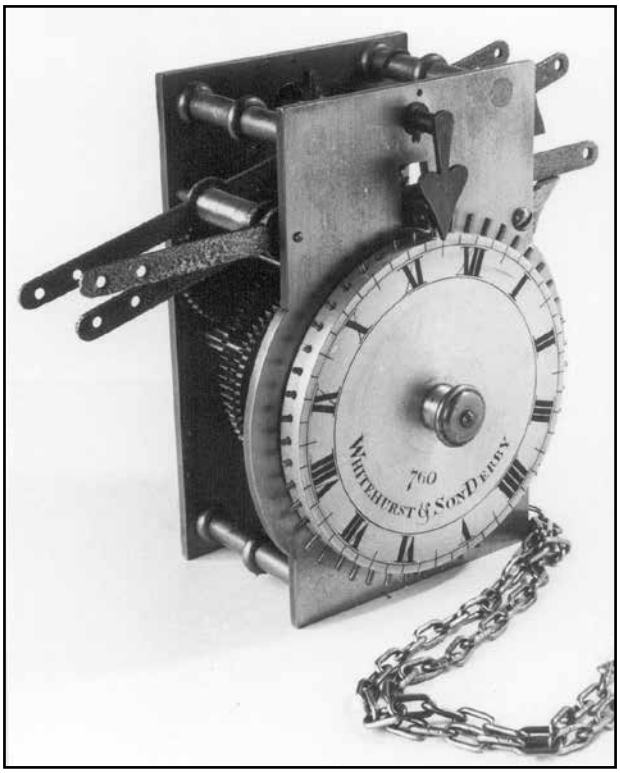

Figure 1. Early design of 30-hour Whitehurst & Son noctuary, N° 760, about 1812, with Roman numerals, adial pins and multiple levers.

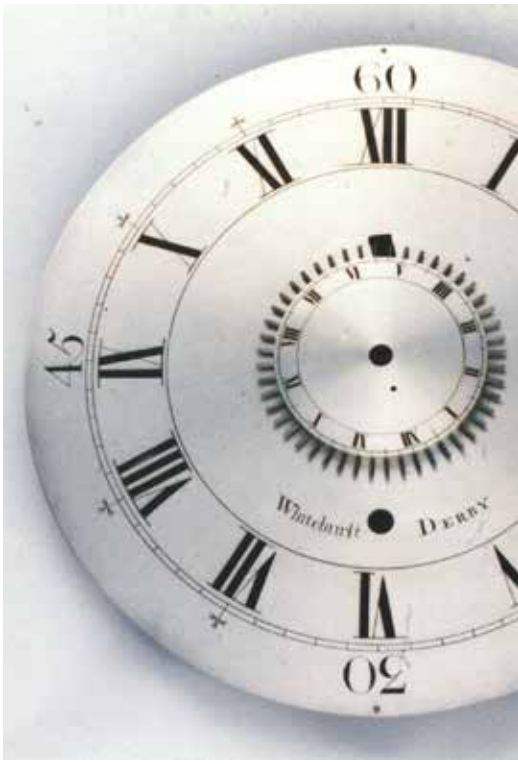

Figure 2. Dial of a Whitehurst longcase clock combined early design of noctuary.

The first question some readers might ask is: 'what is a noctuary?' Various dictionaries define it as 'a journal of what happens in the night', 'a record of what passes in the night, a nightly journal, distinguished from a diary' and 'a journal of nocturnal incidents'. The type of noctuary discussed here is not a written journal, but it does record nightly events, in this case the regular visit by a night watchman—hence the alternative name of 'night-watchman's clock'.

The need for such a device first arose during the Industrial Revolution, especially in the booming cotton spinning mills that started in Debyshire, where Richard Arkwright's newly invented 'water frames' were driven by waterwheels powered by the River Derwent. It was only later, with the development of powerful rotary steam engines, that Lancashire became the dominant force in the cotton industry. The early cotton mills were multi-storey structures, built by traditional methods with the large wooden floors on timber joists needed for the heavy machinery supported by timber beams and pillars.

The floors became soaked with oil from the machines, while virtually everything was covered with cotton dust and fluff—it was a disaster waiting to happen. An overheated bearing or a knocked-over candle and the whole building would go up in flames. Numerous mills were destroyed by fire—Mayfield Mill, only a few minutes walk from where this is being written, was burnt down in 1806, rebuilt and is still producing textiles, though no longer powered by the River Dove.

This was only one of many that suffered this fate. The buildings had to be made fireproof and William Strutt developed new building techniques for the mills he owned jointly with of his father Jedediah Strutt at Belper. Cast-iron pillars and beams replaced those of timber, while brick arches supported floors constructed of brick and plaster, making the structure itself immune to fire. Strutt's iron-framed mills at Belper made possible modern skyscrapers.

But mills were still prone to fires from cotton fluff and night watchmen were employed to check the building's safety. How then did the mill owners and managers ensure that the watchman was conscientious and visited every floor on his nightly rounds? The inventive William Strutt (he eventually became a Fellow of the Royal Society on the basis of his inventions) came up with the answer: the noctuary clock, devised in the late 1780s. This was a timepiece that would record when the watchman visited specific places in the mill.

The principle is a timepiece in a locked case having an external lever. When this was pulled a series of linkages depressed one of 48 pins on a rotating dial, so in the morning the manager would have a fairly accurate confirmation of the times that the watchman had checked this part of the building. There would normally have been a noctuary on every floor, but rare examples are known that could be activated by a number of linkages from different locations.

Noctuaries were soon in use in all sorts of buildings where night watchmen were employed: banks, hospitals, asylums, prisons, government offices and even large country houses. Williams Strutt's watchmen's clocks were made by Whitehurst, the well-known firm of Derby clockmakers, and it was once thought that the founder of the firm, John

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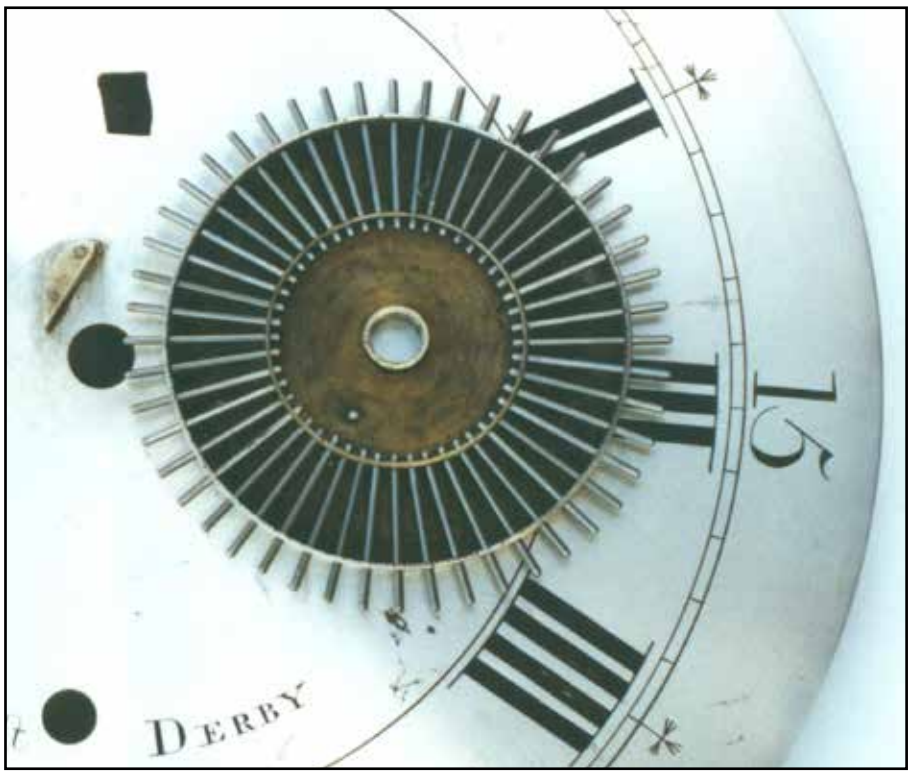


Figure 3. Rear of the early noctuary dial showing the long radial pins. Note the ramp to reset depressed pins.

Whitehurst FRS, had been their inventor, but this is now known not to be the case. Whitehust was the most prolific maker of noctuaries, and they are usually signed by the firm, though occasionally examples were made bearing the name of others, one of whom was not a clockmaker but a nineteenth-century Derby gas engineer.

Neither William Strutt nor the Whitehurst firm patented the principle of the noctuary, so it is not surprising that, once their effectiveness had been demonstrated, other clockmakers started to make them. In particular the London firm of Dent supplied noctuaries to government offices and the Bank of England, while Thwaites & Reed also made them, often with a local clockmaker's name on the dial. Most noctuaries were weight driven, but Dent also made some spring-driven examples.

Whitehurst's early models used a rotating dial with pins projecting radially outwards and the operating lever pushed down on the topmost pin. The typical example in **figure 1** shows the Roman hour numerals that were often used on the early design. The dial rotates clockwise and the time is indicated by a fixed pointer at the top. What is not typical is the multiple lever system, which is very unusual. The linkages are not complete and their precise function is not clear, but presumably pull wires from different parts of a building connected to a single noctuary. This would not have been particularly convenient, for the pull wires would have to be enclosed in some sort of trunking to prevent tampering, and the different times that the watchman visited the various locations could not be differentiated.

To prevent pins sliding down as the dial rotated each one had a small leaf spring at the rear to hold it in position. In addition a ramp behind the disc restored the depressed pins to their original position. The pins and the restoring ramp are shown in **figures 2** and **3**, though the retaining springs are not visible. However, this is not a normal noctuary, but a combined noctuary and a round-dial longcase clock. This type is extremely rare and only two examples are known—this one being in an oak swan-necked case, while another in a most unusual mahogany case is now on display in the Pickford House Museum, Derby.

Not all night watchmen were conscientious and it was discovered that by holding down the pull lever for a while, perhaps by hanging a weight on it, the next pin jammed against the depressed plunger and the clock would stop. This allowed the watchman to sleep though the night instead of doing his rounds, claiming in the morning: 'honest, guv, I was there at all the times I should have been, but it had stopped after the first

by John Robey UK

time'. This was a dodge that was not likely to work very often, and after the noctuary had been checked by the local clockmaker and found to be working correctly, the watchman would probably lose his job. To avoid this problem the fixed plunger was replaced by a spring-loaded tip that would be pushed out of the way instead of stopping the clock if the lever was held down for a long period.

By about 1820-25 the original design with radial pins was replaced by a

Figure 4. Later type of Whitehurst noctuary, 1848.

Figure 5. The unrestored movement in its original case.

simpler method using pins projecting to the front. This eliminated the need for the numerous retaining springs on the pins and enabled a simpler safety device to be used. At the same time there was a change from Roman to Arabic hour numerals. With the earlier model there appears to have been a variety of methods of achieving the downward push of the plunger, but the later version used a more standardised system of two levers to push the pins in from the front.

Figure 7. Rear view showing the sturdy iron bracket for the return spring.

Figure 8. Side view with the lever mechanism to depress the pins.

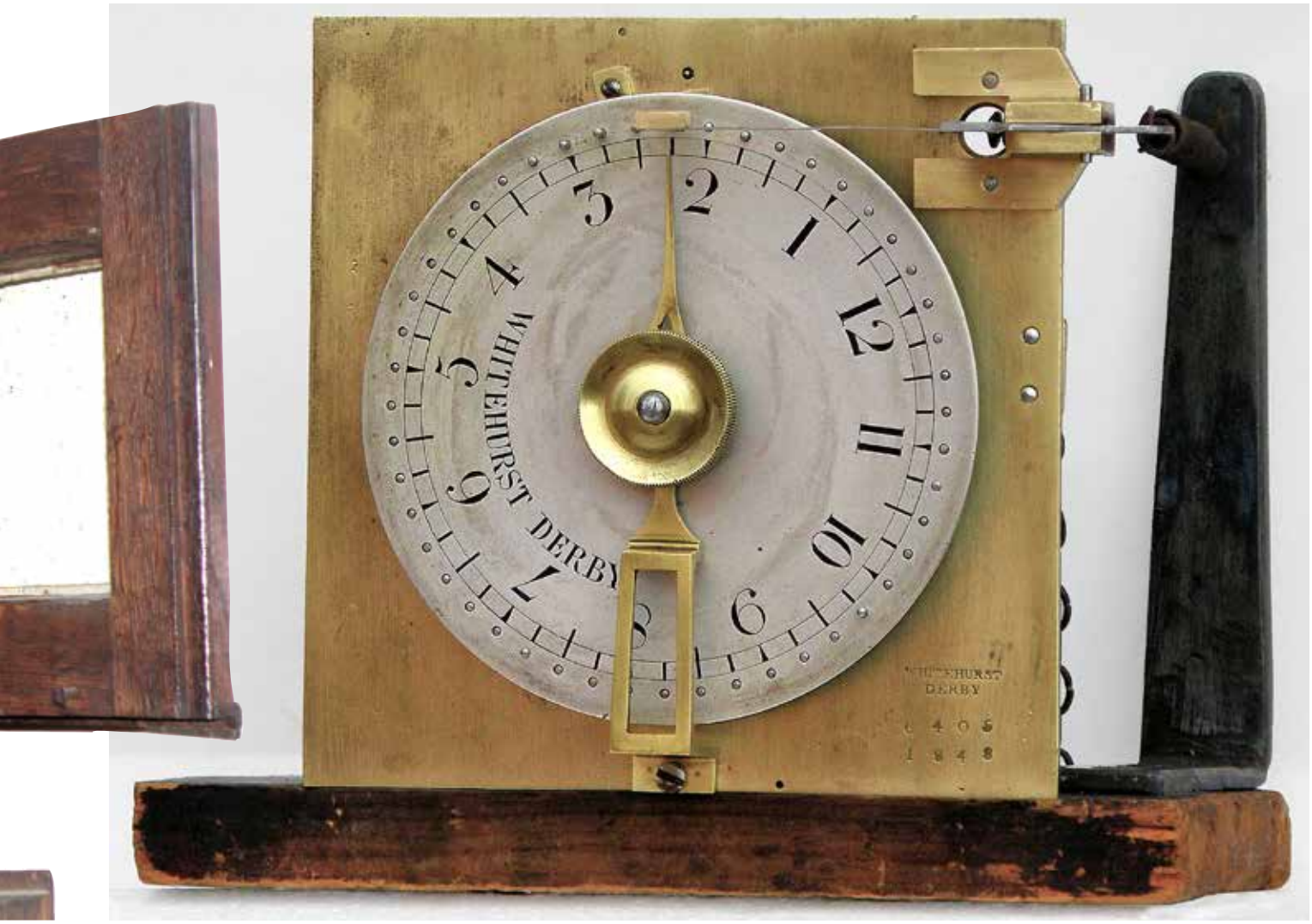


Figure 6. Front of the restored movement.

The plunger was now on the end of a long leaf spring and shaped so that it was deflected upwards instead of jamming. Since the fixed hour pointer that had been used before would now be in the way of the plunger, a long cast brass hand was screwed to the bottom of the front plate, straddling the centre boss on the rotating dial and ending in a narrow pointer at the top. A rectangular 'window' provided greater visibility of the lowest pins. Another important improvement

Figure 9. The four wheels, chain pulley with ratchet and anchor pallets.

Figure 10. The bottom edges of the plates filed with 'IW' for ease of assembly.

Figure 11. Name, number and date stamped on the front plate.

Figure 12. Number and date stamped on the rear plate.

Figure 14. Ramp behind the disc for resetting the depressed pins.

Figures 15 to 17 (lef back cock, hand an stamped on the low

Figure 13. The pendulum flat stamped with a 3 instead of a 4 by mistake.

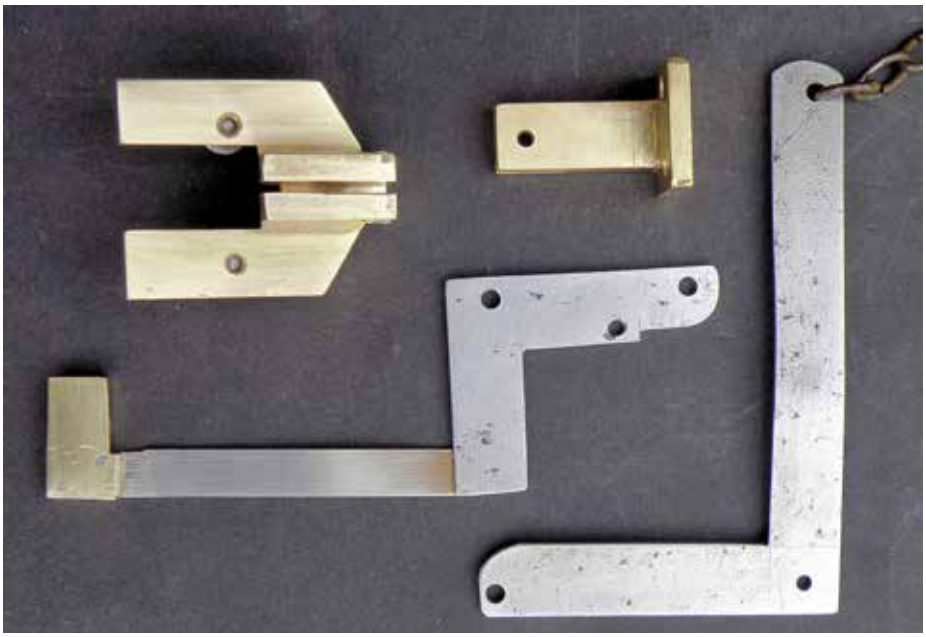


Figure 19. The new brass brackets and iron levers.

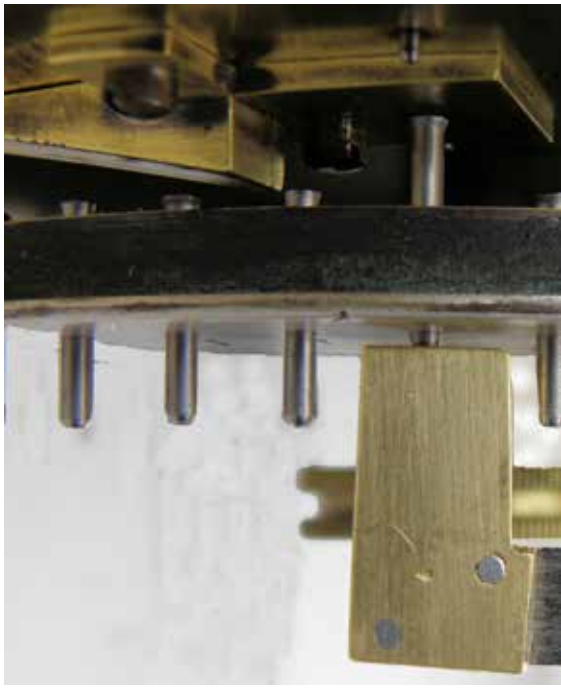


Figure 21. A pin pushed in by the plunger.

was the addition of an extra wheel to increase the duration from 30 hours to eight days.

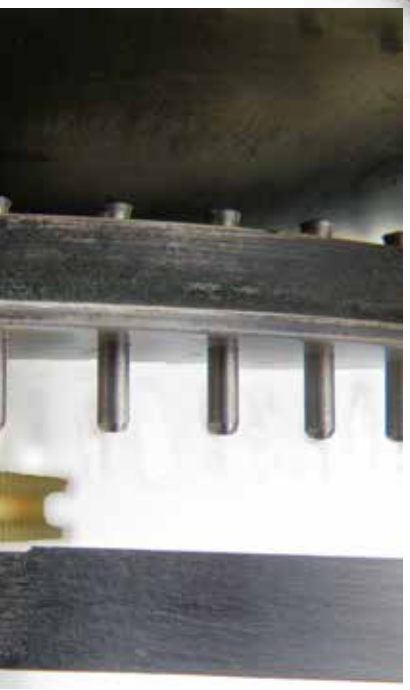
The Whitehurst noctuary in **figures 4** and **5** was acquired several years ago at the Midlands Clock Fair, but it was missing its pins, the operating levers and their supporting brackets, all of which have now been restored. When they were no longer used for their original purpose some noctuaries were 'domesticated' by removing all the operating mechanism and replacing the rotating disc with motionwork and hands and fitting a conventional dial. Some retained their original utilitarian cases; others were fitted into new cases, either miniature longcases or hooded wall cases, or they just sat on a bracket with a box to keep dust out of the movement.

Fortunately, this one escaped most of this indignity and it has now been restored pretty much to as it would have been. However, many more were scrapped and it is reported that when one of the facilities at British Railways' Derby Locomotive Works closed in the 1970s six were thrown on a tip, with just one of them being rescued and nursed back to health.

The early type has received more attention than the later design and no published illustrations could be found that showed the missing parts. So it was a case of 'it's not what you know, but who you know' and a couple of friends allowed me to photograph and measure their similar movements. The first turned out to have been fitted to a backboard and the plunger incorrectly replaced. Although the second had lost its case and the ironwork had been very rusty, the movement was

t, above and above right). The d ramp castings all have '5' er surface.

Figure 18. The heavy brass rotating dial with pins though the rim.



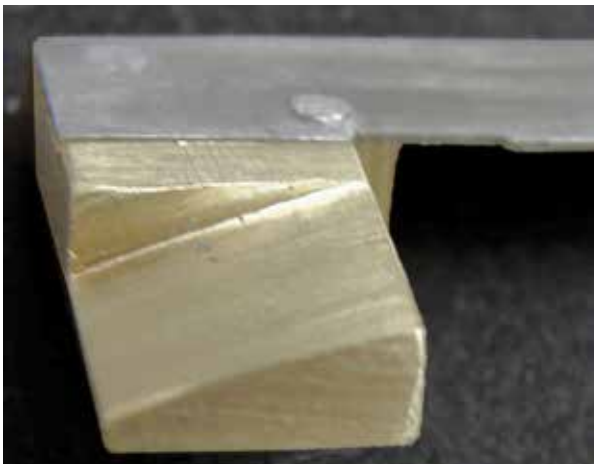


Figure 20. The shaped lower surface of the plunger to prevent jamming.

original. The owner had removed the rust and made a very accurate replica case.

These two movements provided the information to restore the noctuary back to working order, **figures 6** to **8**.

The four-wheel going train, **figure 9**, has the usual Whitehurst chain drive, but instead of a pivoted click acting on a crossing of the greatwheel—the type that was favoured by the firm in the nineteenth century—here there are ratchet teeth cut into the pulley casting. There is, of course, no motionwork, instead the rotating dial is held on the front end of the greatwheel arbor by a large round brass screwed knob. Setting to time is by simply loosening the knob, rotating the disc and retightening.

A major advantage over the usual single-handed longcase clock is that there is no backlash or 'shake' between the dial and the hand. Since the greatwheel turns only once in 12 hours (compared to once an hour for an early lantern clock and four, three or occasionally only two hours for a so-called '30-hour' clock) there is an extended duration. The 5ft (152cm) weight drop gives over 8½ days before winding. There is the usual Whitehurst single-drop cast-iron weight with a small lead counterweight and no 'doubling-up' pulley.

There is no separate dial plate, instead the front movement plate (6¼in, 159mm square) is larger than the rear one (6½in, 159mm, tall by 3¾in, 93mm wide). The pillars are pinned at the rear and the attention to detail is such that the top taper pins are vertical while the bottom ones are horizontal; this was also a practice of the Deacon firm in Leicestershire. The bottom edges of the plates have the file marks 'IW' (**figure 10**) instead of the more usual 'V' to allow the movement maker to instantly know which way the plates should fit together, although the pillars prevented both plates being photographed alongside each other. The front plate is stamped 'Whitehurst Derby 6405 1848' with the number and date repeated on the rear plate (**figures 10** and **11**). However the pendulum is numbered 6305, **figure 13**, which appears to be an error, the workman picking up the wrong stamp for the second digit, which was never corrected.

The ramp for resetting the pins is screwed to the front plate, **figure 14**, and the three original castings—back cock, hand and ramp—all have '5' stamped on their lower surface, **figures 15** to **17**. Clearly just the final digit was sufficient to enable the parts to be fitted to the correct movement. This might signify that these were made in batches of ten movements of the same type, but while a large number of Whitehurst numbers are known there are not enough consecutive ones to be confident on this point. None of the brass parts have the 'IW' casting mark that is sometimes found on Whitehurst clocks. The dial is a heavy brass cast disc with the thick rim drilled for the pins, **figure 18**, and, as mentioned earlier, it rotates with the greatwheel arbor.

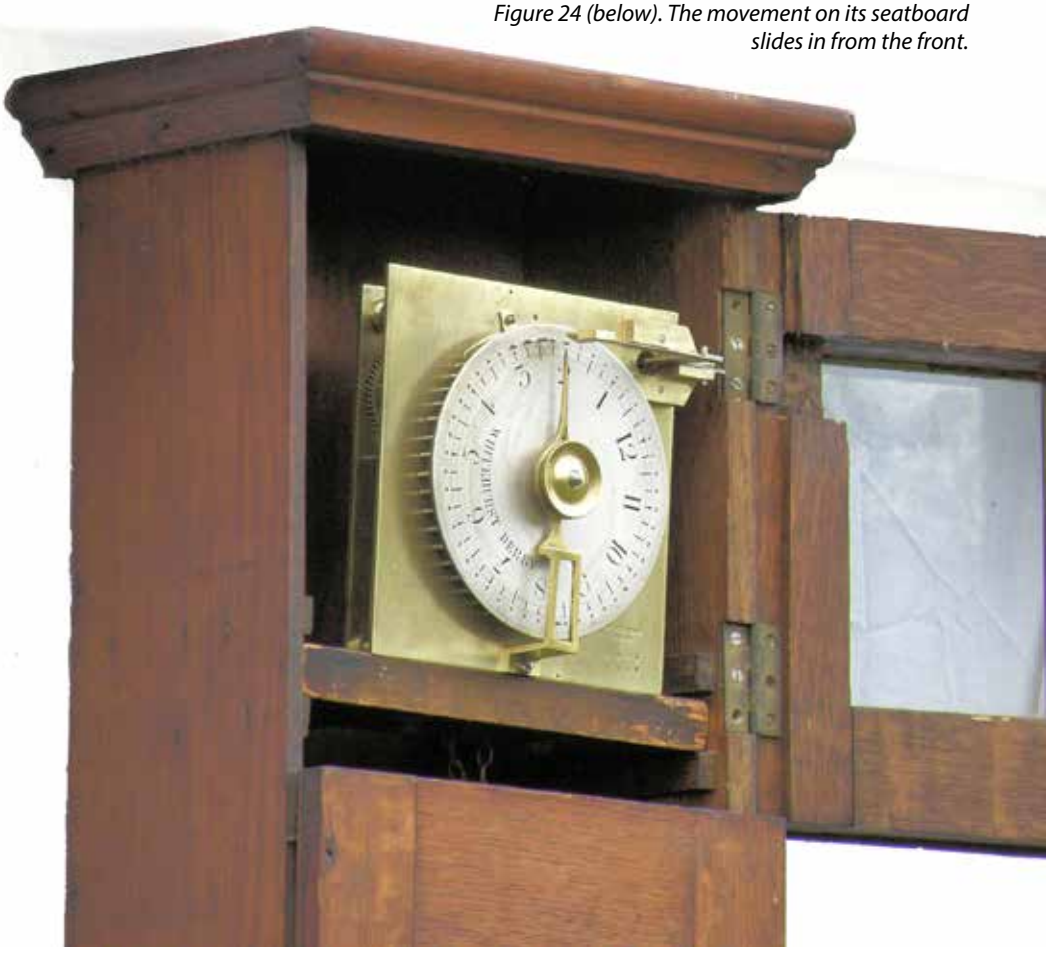
Empty holes on the top right-hand side of the front plate showed where the missing brass brackets for the levers fitted, while three holes in the original seatboard indicated the position of a missing sturdy iron L-bracket for a long coil spring to return the levers after pulling. Noctuaries are one of the few examples in horology where coil springs are used. Rather than cutting wooden patterns and getting castings made at a brass foundry, which would have been the original practice, for one-offs it was more convenient to machine them out of solid yellow brass, though it was rather wasteful of materials.

The lower casting, fixed behind the dial, is a simple L-shape with a pivot for an iron L-lever. This is often called a bell-crank as it was used to turn the wire

Figure 22 (left) The tall slim oak case.

Figure 23 (above). The glass projects forwards to clear the noctuary mechanism.

Figure 24 (below). The movement on its seatboard slides in from the front.



pull of a door bell through a right angle. A chain at the long end of this bell-crank was pulled down by the night watchman. The other end connects via a few links of chain to a smaller L-lever moving in a horizontal plane and pivoted in the top brass block. This block has a more complex shape than the other one as it has to straddle an aperture in the plate to allow the linking chain to pass through and let the lever move without any free play. In addition, and not visible in the photograph, a shallow tenon on the rear surface is a snug fit in a locating recess in the front plate. The arrangement of the two levers is easy to see in **figure 8**, including the return spring. All these parts, **figure19**, were faithfully copied from the examples that had been examined.

The actual brass plunger block was riveted to a long flat spring, which in turn was riveted to the end of the front lever. Hence a pull on the vertical chain moves the top of the bell crank to the rear, this then pulls the plunger on the second lever to depress the pins, while the coil spring returns the plunger to the starting position. A gentle slope on the lower leading edge of the plunger, **figure 20**, acts as a simple safety device. If the lever is held down in an attempt to stop the clock the oncoming pin simply slides underneath and lifts the plunger on its thin spring out of the way. Simple and effective, without the need to have a spring-loaded swivelling plunger as used on the earlier design.

The pins themselves were made last so that the length needed could be checked. Fortunately I had a stock of steel rod of almost the correct diameter and only a whisker needed removing from the holes with a 2mm reamer to give a perfect fit. The pins were parted off to the correct length, the front ends rounded with a file and the rear ends peened over to prevent them falling out. While these operations were done on a lathe a simple jig would have been equally effective.

When adjusting the plunger it soon became apparent that the arrangement is more sophisticated than might at first seem, though this is a consequence of the system, rather than a piece of clever design. It might be thought that the plunger should be just wide enough to push in only one pin, but in practice it must not fall between two pins and fail to record a genuine pull by the watchman. Hence the plunger must be slightly wider than the space between the pins, so that a direct 'hit' will depress one pin, **figure 21**, but a little later two pins will be pushed.

This in effect doubles the 'time resolution' so instead of the recording of the watchman's visit being to the nearest quarter of an hour it can be determined to the nearest half-quarter. If a single pin is found to be depressed then this took place on the quarter hour, but if two consecutive pins are down the watchman made his visit halfway between the quarters, in each case with a margin of error of a few minutes either way, certainly close enough if there was a dispute.

Apart from the two special longcase/noctuary combinations mentioned earlier—there are almost always exceptions in horology—watchmen's clocks are usually housed in very plain utilitarian cases and they are no great objects of beauty. Whitehurst's examples are in tall narrow boxes, the typical one in **figure 22** being 77½in (197cm) tall, the trunk being only 9¾in (24.7cm) wide by 6in (20.3cm) deep with just a skirting at the bottom and a simple moulding at the top (**figure 23**). There is no separate hood, and the movement on its seatboard slides in from the front through an opening glazed door, **figure 24**.

This is the same basic system used on most of the firm's nineteenth-century tall cases, including their striking and three-train ting-tang chiming clocks. They are usually made of stained pine or an unvarnished light-brown oak, though the ting-tang clocks are sometimes in more expensive mahogany cases.

Unlike the majority of conventional longcases, noctuary cases have a base to help strengthen the very basic construction. There is a narrow half-length trunk door and a similar panel below. This is held with turnbuckles so it can be removed if the weight or pendulum was dropped inside as they would otherwise be very difficult to retrieve. These narrow cases need to be fixed firmly to a wall to prevent toppling over. Once the turnbuckle (missing in the picture but subsequently restored) on the glazed door has been closed and the trunk door locked the mechanism is immune from interference by unauthorised persons.

The early type of noctuary was fitted in an identical case apart from the glazed door, which was almost flush with the front. However, since the levers on the later type push the pins from the front clearance has to be made for this and the glass is held in a projecting frame and this feature enables the two types to be distinguished at a glance.

Some noctuaries have a short lever protruding though either the front or the side of the case, both of course on the right. The watchman had access to the outside of the clock and both he and the other employees could use it as a works clock. There is no such aperture in this case, instead a slot in the backboard, **figure 25**, shows clearly that the operating chain or wire exited to the rear via a now-missing pulley.

The case would have been fixed to the inside wall of an office, or somewhere

Figure 25. The pull chain exited round a pulley and through a hole in the backboard.

similar—perhaps even the butler's pantry of a large house—with the pull being through the wall. Not wishing to knock a hole though the wall the pull chain now just hangs down inside the case so the trunk door has to be opened to demonstrate the operation of the recording mechanism, but at least it is now back to almost its original state.

It would be fascinating to know where this noctuary had been used, but that information is now unlikely ever to be discovered. While each Whitehurst clock made at this time had a unique distinguishing number, no records survive to show to whom they were sold.

Noctuary clocks were used to great effect from the late eighteenth century to well into the twentieth century, to help track the movements of watchmen—one cotton mill even used them until it closed in the 1960s. The fixed type, as discussed here, were eventually replaced by portable spring-driven timepieces with lever escapements and a series of 'keys', each fixed by a chain, to one of several stations throughout a building.

During his rounds the watchman would insert each key in turn into his machine, which he carried in a leather case on a strap over his shoulder, to leave a unique impression of the time and in what order he had visited the stations. Now even these have become redundant and are collectors' items, and the night watchman and his noctuary has largely been replaced by automatic sprinkler systems, smoke and fire detectors, intruder alarms, close-circuit television, swipe cards and other electronic and digital devices. Along with mill clocks and clocking-on clocks noctuaries played an important role in the history of timekeeping in industry.