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A Turret Clock by William Clement

The Hon. G. W. Bennet describes a clock dated 1672 with an anchor escapement

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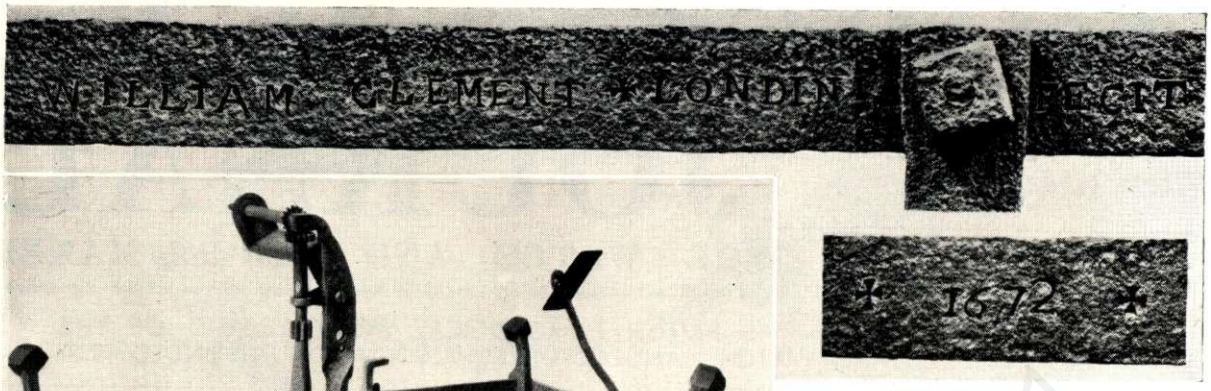
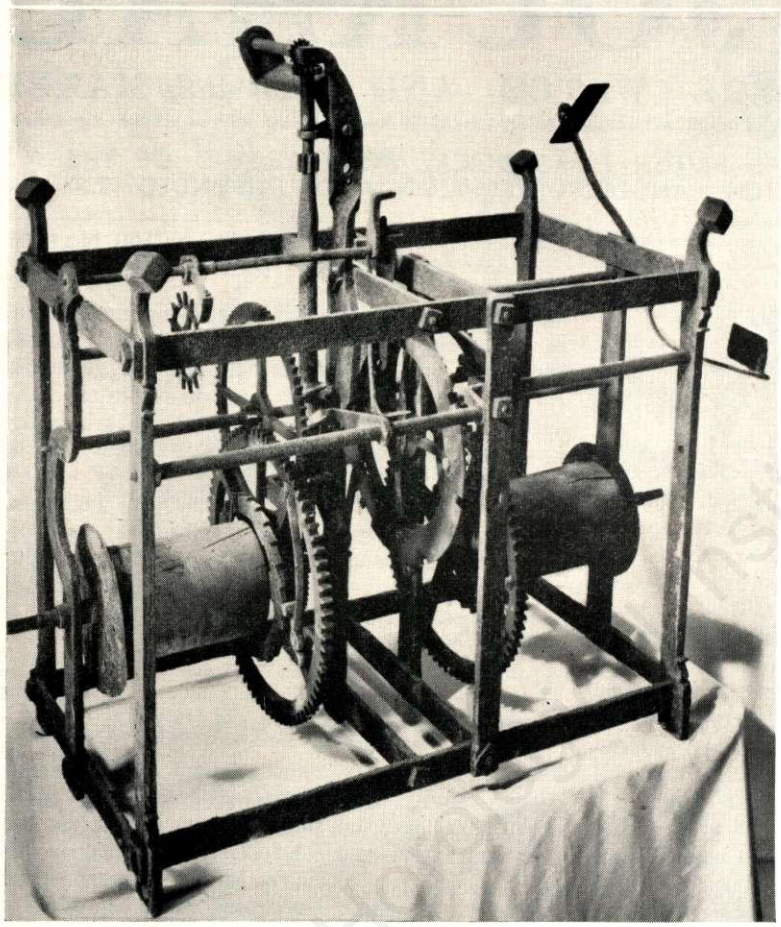


(Above) The name and date. This has been slightly retouched to aid its reproduction.



(Left) Fig. 1. The recently-discovered Clement clock which is fitted with an anchor escapement. The unusual layout provides space for a central pendulum, the crutch and part of the suspension spring for which can be seen. Also near the centre of the movement is a vertical arbor to drive the hand or hands from the going train on the left. A worm integral with this vertical arbor raises the lifting piece on its arbor (to be seen in front of the locking plate) until it drops off the worm edge, when it releases the striking train on the right. The worm action is rare. There are other examples in the clocks at Shottesbrook and Bisham, both in Berkshire.

A Turret

The Hon. G. W. Bennet

describes a clock dated 1672 with an anchor escapement

A MANTELPIECE is a bad place for a clock but a clock tower is even worse. Birds and bats share the damp and draughty clock chamber and help to stir dirt and stone dust into the movement, forming a grinding paste with the unsuitable oil lavishly spread by unskilled attendants. Early clocks became unpopular because the required frequent winding and, being rather large, were apt to be left in the open when once they had been superseded by newer machines. Small wonder then that few survived and these in poor condition or extensively restored.

The specimen illustrated has indeed suffered from dirt and exposure but fortunately the only major overhaul left most of the original parts intact. On this occasion the repairer conceived the ingenious plan of reversing both trains of the clock.

To justify this statement it is necessary to set out the steps by which the conclusion was reached.

On first seeing the clock it seemed that the maker's name was on the wrong side since anyone winding it would naturally stand so that he wound away from himself. The great merit of having the trains end-on instead of side-by-side is that both can be arranged to wind away from the operator, as in winding a bucket from a well, whereby he can bring more power to bear and wind faster. The system is seldom found in later clocks because it requires more space and more bars in the frame. Capstan-bar winding was out of date by Clement's time and there would have been no room for an adult to grip the bars in this case.

Next it was noticeable that the second wheels in both trains were worn on both sides of the teeth. It is common enough to find that turret clock wheels have been turned about where attached to the arbors by nuts or pins but it is not so easy to do where riveted to the pinions as here. The two great wheels also showed wear in both directions but less obviously. After removing some of the rust and dirt from the pinions both sides of the leaves could be seen to have been used which proved that the trains had actually run both ways.

It remained to discover what other alterations had been needed in making the clock run backwards.

In Fig. 1 a rectangular hole appears in the vertical strap carrying the strike-lifting piece and a round hole in the ornamented bar on the right; these are for the former location of the hammer lever.

The second difficulty was the direction of rotation of the worm on the vertical arbor which engages the lifting piece. In Fig. 2 a small transverse hole can be seen at the bottom of this arbor; this is for the pin through the brass collar, now located higher up.

With the collar at the bottom, the wheel on the vertical arbor rests on it and engages direct with the

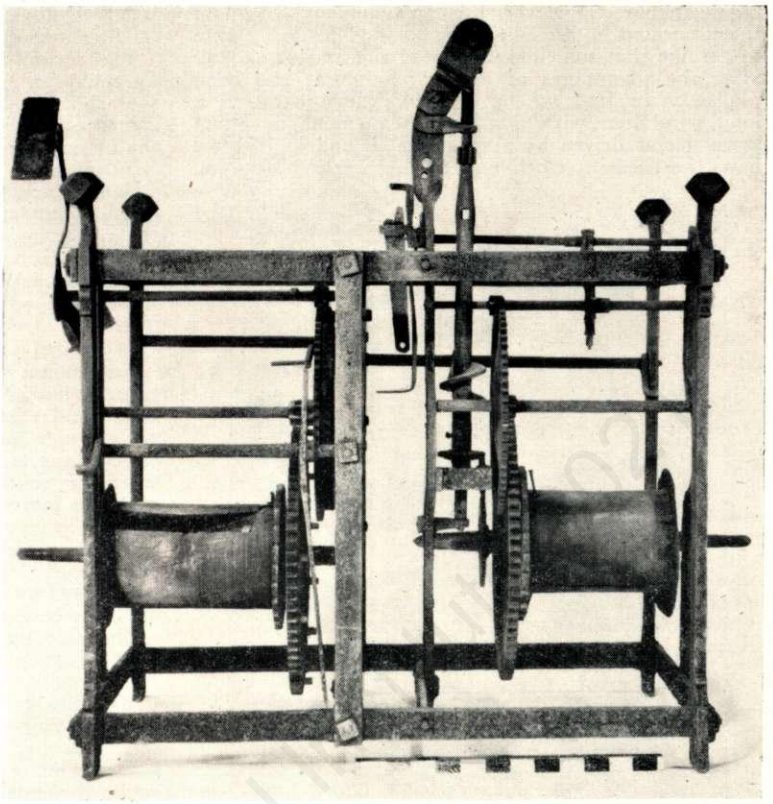


Fig. 2. Another view of the clock. The idler wheel inserted between the wheel on the vertical worm arbor and the drive from barrel arbor can be seen.

Figs. 1, 2 and 3 are by courtesy of Dr. F. A. B. Ward, and the Antiquarian Horological Society.

Clock by William Clement

barrel arbor, so the idler wheel and bracket were put in to keep the worm going the same way when the train was reversed.

With such a frugal restorer it is not surprising that he used the old click springs by exchanging and re-planting them. The old screw and steady-pin holes in the great wheel on the going side show up in Fig. 3 near the lowest point on the wheel and just to the left of the bar which carries it. The ratchets were only screwed to the wood of the barrels so they were no bother and the clicks were exchanged and re-riveted.

The locking plate was a little more troublesome; two holes were plugged and re-tapped but there are some assembly marks to show how it went. No other changes were needed on the strike side save to reverse the bend in the stop pin projecting from the fly arbor.

The escape wheel and pallets are not original, but whether they belong to the period of the Great Reversal is hard to say; personally I suspect that they have been altered more than once.

Economical Design

Except for the traditional ornamental mouldings and finials the frame is of a simple design giving rigidity with the minimum waste of material; in modern jargon it is "functional."

The wheelwork is planned to keep down labour costs by having two great wheels each of 78 teeth and 12¼ in. diameter by $\frac{7}{16}$ in. thick; these could be cut together whether the method was by fly cutter, by filing jig or by marking out. Better still, the two second wheels and the locking-plate wheel are identical, all being 9⅝ in. diameter by ¼ in thick with 72 teeth.

The vertical arbor is easier to make than it appears; the worm is just a strip brazed on. To ensure that it remained in position during the brazing the helix was given 1¼ turns instead of the one turn which could actually be used and since the extra did no harm it is still there. As a way of raising the lifting piece the worm has the advantage of distributing the action over a longer period than obtains with the more usual lifting pin.

The upper end of the arbor is pierced with a rectangular hole which must once have held a projecting knob to help turn the hands; this same shape and size of hole is used at the intersection of the bars in the frame and for the eye supporting the hammer lever mentioned above.

It will be noticed that this train with the customary pinions of six and 15-tooth escape wheel beats 39 to the minute and not 40. Nevertheless it was not just a bad guess for a 1½-second pendulum but the natural result of symmetry; if you want identical trains making exactly the same revolutions per day and also one of the wheels to carry the locking plate, there are not many ways of obtaining an exact whole number of beats per minute.

The barrels are 4½ in. diameter and make 12 revolutions per day so that about 16 ft. of ½ in. diameter rope is wound on for 24 hours running; this is quite reasonable and not as much, in fact, as some Gothic chamber clocks.

Authenticity

In discussing a turret clock of 1672 one should bear in mind the changes which had taken place in English clockmaking; the screw had ousted the wedge for securing the frame, brass had become relatively cheap, lathe work was common for ornamental as well as useful purposes and the pendulum was being fitted to all clocks. Though Clement was a member of the Blacksmiths Company, as were most "Great Clockmakers," this does not mean that he was any less modern in outlook than Tompion who had only just become a member of a Company. Whether the anchor escapement is due to Clement remains doubtful; the claim is based on Smith's "Horological Disquisitions" which is not very explicit. The long pendulum hardly counts as an invention; once you have a pendulum, its length can be the subject of anyone's experiment.

Unfortunately this issue has been fogged by writers stating that you cannot have a long pendulum without an anchor escapement, whereas there are vast numbers of French country-made movements of no great antiquity using crown escapements with pendulums up to 1½ sec. describing arcs no larger than that of a

recoil anchor. However, this arrangement is seldom if ever found in English work so it is probably safe to assume that somebody invented the anchor shortly after the advantages of longer pendulums had been realised. In 1669 we have Hooke demonstrating a long pendulum with a crown escapement in effect since it was driven by a verge watch and in 1671 we have the Clement clock now in the Science Museum.

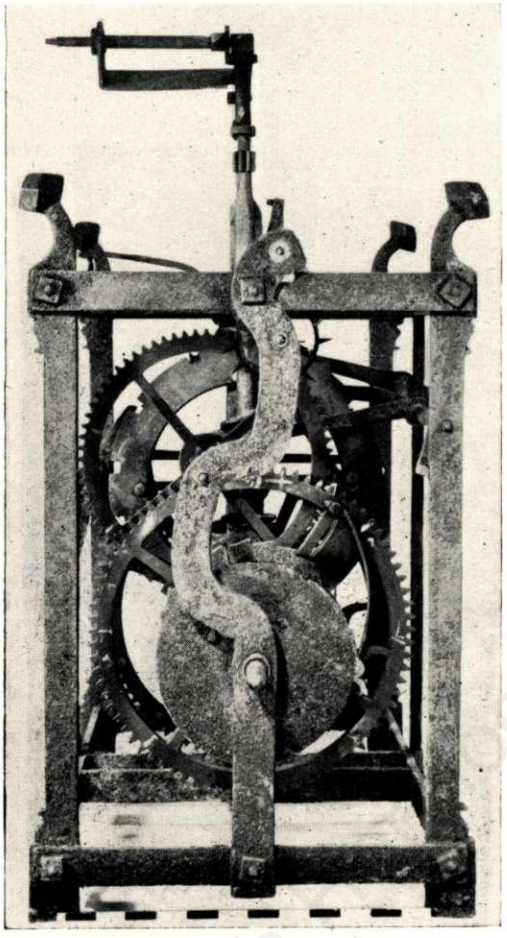


Fig. 3. The brass wheels are seen well here.

If it is difficult to see how the 1671 clock could ever have had anything other than a pendulum, in the 1672 clock it is quite impossible. Furthermore, it must have been operated by an anchor escapement because there is nowhere to put anything else.

It begins to look as if Clement really was the first constructor of this type of clock and the founder of a style in turret clock making which lasted for over 150 years.

Of course it might be suggested that the whole mechanism has been rebuilt using only the old frame, but this is straining at a gnat and swallowing a camel. The frame is the easiest part to make, even such a well-made frame as this one.

There is no reason why the brass wheels should not be original; the amount of wear is consistent with 250 years of use. The nearest comparison I can offer is a turret clock wheel for which I cut a replacement two years ago, the original having been reversed and worn out in both positions. This process took almost exactly 200 years while it ran as the third wheel in a four-wheel train which drives a seconds pendulum. Clement's second wheel, running at slightly less speed and with 20 per cent wider teeth, has not quite arrived at the same stage but very near it.

The second-wheel pinions appear original and the fly could be, but the escape pinion definitely is not; the arbor has been filed hexagonal and another pinion driven on. The new part has circular addenda while the other have the cycloidal form.

There is no need for caution in claiming that the locking plate dates from 1672; even if locking plates had any tendency to wear out this monster would be the last to go. It is worth noting that the holes were punched, raising slight bulges on the inner rim.

One can assert with equal confidence that the great wheels are original and still have a lot of work left in them.

Alterations to Escapement

An amount of work sufficient to wear this massive train is likely to have worn out at least one escape wheel and there is other evidence of changes.

The outer top bar of the frame (Fig. 3) has a notch which apparently gave clearance for the pallet staff when the centres were closer together than they are now, the increased distance being obtained by slightly straightening the top bend of the bar which carries the train. There is no notch in the inner top bar to correspond which, I suggest, is because the former pallet staff was shorter and carried on an entirely different cock at its inner end.

The existing cock has an unwanted hole plugged with brass and further brass plugging around the screw, but its steady pins are not of the old type and fit in holes drilled right through the upright.

Above and below this cock are two old-style blind steady-pin holes which would suit the earlier pin made from the solid by staving up the edge of the cock; the lower hole is so close to the cross bar that this is the only way it could be used.

This older cock curled round towards the escape wheel and allowed the crutch to come down inside the frame and its foot to work in the space provided by the C-shaped bend in the bar carrying the train. This would allow the pendulum to hang further away from the locking plate.

I can think of no other solution of the problem save that the pallet and escape wheel arbors were wildly out of parallel which, as Euclid would say, is absurd.

Present State

Strangely enough most of the corrosion is recent and yet some attempt has been made to keep the clock running in modern times.

Signs of this are the remains of a split pin holding the fly and marks of wire rope on the wood of the barrels in one of which is stuck a very rusty wire nail.

Traces of blue, white and black paint can be seen here and there, enough to have obliterated the signature altogether perhaps, but not enough to preserve the metal once it was thrown out in the open.

However, it has proved possible to dismantle the trains and make certain of the accuracy of the foregoing statements by trying the parts in their original positions. Two points were clearly proved: the strike arm stop is correctly curved for its proper station whereas it is wrong as shown in the photographs, and the drive to the worm shaft is beautifully free of backlash without the intermediate wheel.

Whoever the Great Reverso may have been, he does not belong to the school of Clement, otherwise he would have made an opposite handed worm instead of adding a wheel and an excess of backlash therewith.

Motion Work

The most formidable problem of all is posed by the motion work.

We can at once dismiss the existing hands, dials and two sets of motion work of different dates (not shown in the illustrations), also the one surviving

Concluded on page 367

referred to another meeting he had attended at which Mr. Halsey had been in the chair. He had managed to tell everyone a lot about the work of the Society, with the result that he raised quite a nice sum of money.

Mr. Halsey was unanimously re-elected and commented that he was glad the Society was not as hard up as it had been some 20 years ago—at that time it was difficult to raise £50 for grants in aid, much of which went to solace applicants who had been unsuccessful in the pensions election. Things were different now. During the past year over £230 had been spent on grants in aid, and none of this money had gone to unsuccessful candidates—it had gone to help those who did not fully qualify under the rules for a pension. There were no unsuccessful candidates now. No deserving case was ever turned down.

The trustees of the invested funds were re-elected: Louis C. Baume, J. A. Daldorph, H. W. Elliott, Ralph B. Halsey, Robert Pringle, K. J. Stockall. The resignation of Mr. W. Burn from the Committee was accepted with regret. Mr. Halsey moved that Mr. K. J. Stockall should be elected in the place of Mr. Burn, together with the retiring members: Messrs. L. C. Baume, R. de Cintra, R. B. Halsey, A. E. Pearson and E. A. Richard.

* * *

At a meeting of the Committee held immediately after the annual general meeting, 10 pensioners were added to the list. This made the total 130, which constituted a record number.

Mr. A. E. Pearson was unanimously elected Chairman of the Committee. Before moving his election, Mr. Elliott expressed his thanks to the Committee for having granted him the privilege of being Chairman for the past three years.

Mr. Pearson said he had the greatest admiration for the wonderful work the Society did for the trade it represented.

Mr. Gerald S. Sanders was unanimously elected Vice-Chairman.

The next meeting of the Committee will be held at "The Homestead" on July 24, 1956.

The Clement Clock *Continued from p. 350*

horizontal lead-off rod with its pinion of modern brass and brackets of cold-worked modern steel strip; all these belong to XVIIIth and XIXth century reconstructions.

I expected to find that the square at the top of the worm shaft was an addition but it appears to be integral with the rest; the pinion which covers this square in the photos also seems to be old or at least older than either set of motion work. The only conclusion seems to be that the clock always had a minute hand driven from the pinion at the top and an hour hand driven from the eight-leaf pinion below. A contrate of 96 to engage the lower pinion would come on the same centre as the drive to the minute hand.

Of course, there is no reason why it should not have two hands; minute hands had been common enough in the XVIth century and Albrecht's "Raederuhr" even illustrates a Gothic clock with a seconds hand, but these were domestic clocks.

If we knew the situation for which the clock was built it might help but as it has evidently had two if not three other sites, not necessarily in the same building, the first may take a long, long while to find.

This specimen is said to have come from a district which Clement or one of his workmen would have traversed if supervising the installation in Cambridge of the clock now in the Science Museum.

All that is needed is for some local historian to abandon for a moment his study of the resting places of the much-travelled Tudor Queen and produce an article entitled "William Clement Slept Here."

Dr. Woolley Addresses East Sussex BHI Branch

THE first Annual General Meeting of the East Sussex Branch was held at Southover Grange, Lewes, on May 24. The Chairman, Mr. A. E. W. Christie, in opening the meeting, said that they were privileged to have present Dr. Richard van der Riet Woolley, OBE, FRS, MA (HM Astronomer Royal), who had honoured the Branch by agreeing to become its first President.

Following official business, Dr. Woolley gave an address on Time Determination.

Dr. Woolley said how greatly he supported any endeavour to improve the standards of British skill and craftsmanship which were so necessary if we were to maintain our place among the leading nations of the world. He continued by describing how time could be determined from a sundial, and pointed out the disadvantages of time determined in this way, due to the inequality of solar days, resulting from the obliquity of the ecliptic, and the inconvenience of taking local time as a standard. To overcome these difficulties, Greenwich Mean Time was adopted as a universal standard. He then described the function of a transit instrument, and how a meridian plane might be constructed. The degree of accuracy of time determined by the use of a transit instrument was sufficient to show errors in even the best of pendulum clocks, which were subject to variations in rate of up to 0.1 second per day due to temperature and barometric changes.

Dr. Woolley recounted how, when he was first at Greenwich some 30 years ago, the standard was then the Shortt free pendulum clock.

Nowadays, the Observatory was expected to maintain a time standard to within milliseconds, and this had become possible by the installation of groups of quartz clocks, whose accuracy was such that variations in the speed of the earth's rotation could be discerned. This extreme accuracy, although not necessary for normal purposes, was essential for the control of radio frequencies, and it was hoped to obtain even greater accuracy by the use of an atomic clock, whose time would be dependent on the natural frequency of cæsium atoms.

Another important user of time was the navigator, and Dr. Woolley explained how the Royal Observatory was first set up by Charles II for the purpose of discovering a method of determining position at sea. Latitude could be simply obtained; longitude, however, necessitated the keeping of a standard time.

One method was by using the moon as a clock, and much of the work of the first Astronomer Royal (Flamsteed) was devoted to the compilation of accurate tables of the moon's position. The other method, of carrying a precise timekeeper, presented much difficulty at the time.

As chronometers came into general use, observatories were established at principal ports, where masters could compare the rates of their instruments with the standard clock.

At Greenwich, a time ball was dropped at midday, enabling ships in the Thames to check their chronometers, but in more recent times this had been superseded by radio time signals and TIM. The most comprehensive series of time signals, however, was that broadcast by the American station WWV.

Committee for ensuing year, and Branch Officers: President, Dr. Richard van der Riet Woolley, OBE, FRS, MA (HM Astronomer Royal); Vice-President, A. D. Bruford; Chairman, A. E. W. Christie; Vice-Chairman, D. W. Evans, FBHI; Secretary, J. A. E. Hills; Treasurer, D. E. Slydel; Assistant Secretary, H. D. Edwards; Committee, R. D. Slydel (Social Secretary), W. Roseman, C. A. Edwards, H. C. Goodman.

Secretary: J. A. E. Hills, "Sunnybank," 12 St. Mary's Road, Ocklynge, Eastbourne.

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