A BERTHOUD CHRONOMETER CARRIAGE CLOCK

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It's always a pleasure to work on a well-designed and constructed clock. When the clock is also beautifully finished and has a bit of historical significance to it, or its maker is important, that only makes working on it much more interesting. But before I get into the mechanisms and repair experiences I had, a little background on the clock itself should add interest and perspective to this story.

The clock in question is a Berthoud (Figure 1). The best guess is that it was made circa 1870 by Auguste-Louis Berthoud, a descendent of the celebrated Ferdinand Berthoud who died in 1807. In his book *Carriage Clocks*, Charles Allix pictures a nearly identical clock (Plate V/12 in his book) and writes that it is a matter for speculation which member of the Berthoud family made it. But because of its style of movement, escapement, case, and handle, Allix dates the clock "near the end" of the nineteenth century and notes in the same paragraph that Auguste-Louis Berthoud's name appears on a chronometer numbered 47 that was made in the second half of the nineteenth century. Tony Mercer, in his book *Chronometer Makers of the World*, lists Auguste-Louis Berthoud as living from 1828 to 1910 and making 150 chronometers in 27 years. Thus, it seems most likely that Auguste-Louis was the Berthoud who made this clock.

Further discussion and correspondence with experts on carriage clocks produced some interesting information and opinions that pointed toward the possibility that another, lesser known, French clockmaker by the name of Edouard Francois was its maker. In *Carriage and Other Traveling Clocks* by Derek Roberts, Figures 13-17a and b, there is a movement very similar to the subject movement, except that the movement depicted is equipped with a spiral wire gong whereas the subject movement has a bell and a platform escapement bridge that is quite different from the one on the pictured clock. Roberts indicates that the clock in his book is an Edouard Francois No. 1 Chronometre Brevete S.G.D.G. Its remontoire spring barrel and other parts of the movement are identical to the subject clock movement, however. Roberts also refers to a similar clock illustrated in Joseph Fanelli's *A Century of Fine Carriage Clocks*, number 64. It shows a similar but unnumbered clock signed Ed. Francois on the dial with a stamping on the backplate that reads BTE S.G.D.G./E.F./PARIS, which may refer to his patent on this version of the remontoire escapement. Another clock carrying the name Edouard Francois and numbered #24 was pictured in Roberts' book *The Art & Craft of Clockmaker III*. The layout of his dials is the same as in the subject clock and the one reported by Fanelli. And, like the Fanelli movements, the #24 is also equipped with a spiral wire gong and similar stamping on the backplate. It has a chronometer escapement and exterior parts, except for a lifting lever, identical to and positioned like those of the subject clock movement. This depiction in Roberts' book included a close-up photo of the platform escapement and a diagram of the remontoire system, from the going barrel up to and including the remontoire spring barrel. I have borrowed from that diagram and modified it to illustrate the remontoire system of the subject movement, as shown later. One curious difference, among several small differences, between the subject movement and those carrying Francois' stamp, is that the Francois movements are reported to have polished steel pillars while the subject movement and at least one other marked Berthoud have brass pillars. The significance of this difference is not clear. Another Francois clock has also emerged, being pictured in Derek Roberts' website in early

Figure 1. A Berthoud chronometer carriage clock, attributed to Auguste-Louis Berthoud.

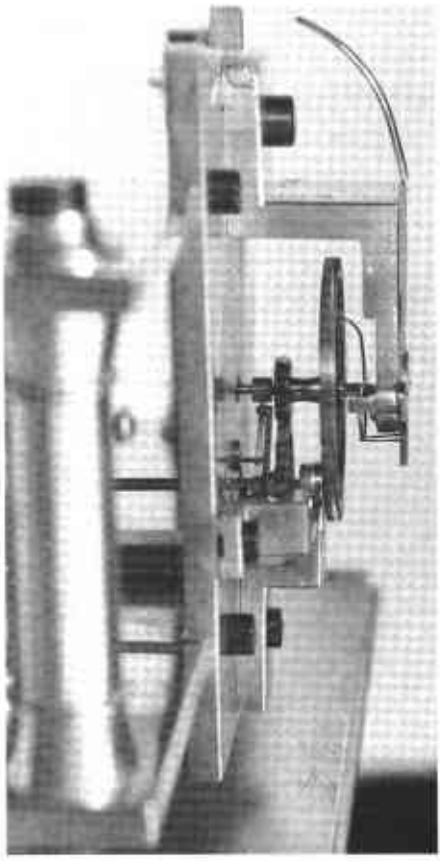


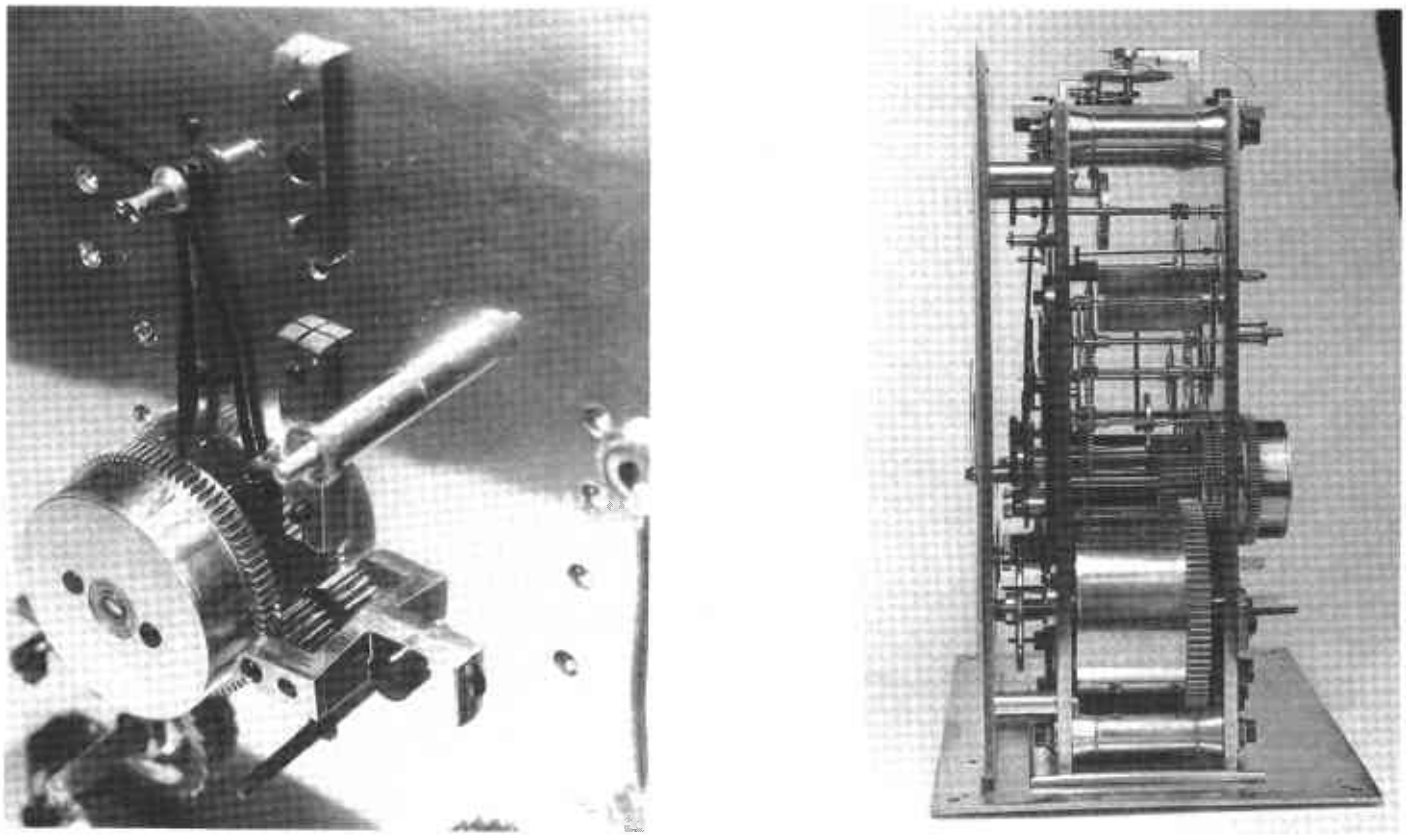
Figure 2. The escapement seems to be a combination of the spring detent and that called a "bascule," a form generally found in watches. (This view is tilted 90 degrees.)

1999, though it appears to be identical to the one pictured earlier in Fanelli's book and is similarly numbered. In my correspondence with both Mr. Fanelli and Mr. Roberts, two different opinions emerged as to the relationship between Francois and Berthoud. One believed that the clocks signed Berthoud were actually made by Francois and the other believed they were not made by Francois for Berthoud.

This chronometer carriage clock is quite large for a carriage clock, measuring 12 inches tall with the handle up and nearly 7 inches wide at the base. It differs from the clock pictured in Allix' book in two ways. One, the Corniche case in Allix is not engine-turned, and two, the description by Allix does not mention a remontoire. A similar clock attributed to Berthoud is also pictured in Derek Roberts' book *Carriage and Other Travelling Clocks* (Figures 13-16), which is described as having a remontoire as well as moon phases incorporated into the seconds dial, grande sonnerie striking, and a more elaborate case with columns and bun feet. Yet another similar clock is shown in Roy Ehrhardt's *Foreign Clocks, Book 5* (page 58) from a catalog of Astor Galleries with features similar to that in Roberts' book but with a mahogany case. Ehrhardt's *Book 3* pictures a clock taken from a Sotheby's 1984 auction catalog that is described and pictured to be the same as the subject clock. Christie's auctions have likewise included a number of similar clocks signed Berthoud. In 1992 their London auction included one that was quarter-striking on two gongs (lot 25), and their 1998 Kensington auction included lot 64 which was similar in appearance to the subject clock except that its striking utilized a coiled gong. Most recently, Sotheby's pictured a giant gilt-brass chronometer carriage clock with remontoire by Berthoud as lot 216 in its March 1999 London auction, including a leather travelling case and striking on a coiled gong.

Based on these few examples, at least, it appears that this maker identified as Berthoud made a smaller number of similar chronometer carriage clocks, but no two exactly alike. While there are no serial numbers routinely visible when this clock is assembled, the number 24 is found on both plates and some other parts when disassembled. Some hand filing marks suggests that the plates and other parts are hand finished, and the words TOOMAS NO. 2 are found engraved on the balance and the bottom of the cock. Their significance, however, is not known. Based on Fanelli's statement that Francois was working in Paris between 1880 and 1890 (information drawn from Tardy's *Dictionnaire*), and Mercer's statement that Auguste-Louis Berthoud lived from 1828-1910, it's a safe bet that the subject clock originated in the last twenty years of the nineteenth century. Since both makers were contemporaries, either could have made it. But until we have further evidence, the writer will stay with Berthoud as the maker of the subject clock because his name appears on it as well as on a number of others very similar passing through reputable auction houses. This clock, which is likely the one included in the New York auction of Sotheby's in October 1984, found its way to its present owner in early 1995. Having eight or so clocks whose movements appear to be made by the same maker, then having some of them carrying one name and others carrying a different name really muddies the water. Hopefully, this article will bring further information or insight from readers about these clocks, their makers, and their history.

In my part-time practice of repairing and refurbishing antique clocks I have the pleasure of working on many interesting pieces, some of which greatly challenge my skills, knowledge, and experience. Because many of the clocks that I work on were originally handmade, the task of repairing them and making their complicated mechanisms function like their makers originally intended turns into quite an undertaking. But rarely does one come to me that is as delicately constructed with as complicated mechanisms as found in this clock by Berthoud. To some of these mechanisms I had no previous exposure. Then, to further complicate matters this clock had undergone the catastrophic experience of having a mainspring rupture, and the attempts of previous repairers to put right the resulting damage. The problem that its owner related to me was that the remontoire mechanism would not always stop winding when it was supposed to. And he informed me about the mainspring break and at



Figures 2A and 2B. Two views of the movement.

least one other repairer's attempt to mend the damage caused by the mainspring break. I agreed to take it in for examination, but reserved the right to return it to him if I felt that the complications and/or needed repairs were beyond my abilities.

The clock has three most interesting mechanisms that most clock repairers rarely have the occasion to work on. Actually, I had never worked on a clock having any of these types of mechanisms prior to its owner entrusting me with the opportunity to repair this clock. The first of these three mechanisms is the chronometer escapement, the second is the remontoire system that provides the escapement power, and the third is its type of up-down indicator and stop work.

THE CHRONOMETER ESCAPEMENT

Because I have found no picture/drawing or other description of an escapement quite like the one in this clock, I will refer to it as being a "pivoted spring detent." It appears to be a combination of the spring detent, like that originally invented by LeRoy and later improved by Earnshaw, a form generally found in marine chronometers, and that called the "bascule" which is a form generally found in watches (Figure 2). Instead of having a locking detent fashioned like that of Earnshaw's, the locking detent in this case has a coiled hair spring which returns the locking detent. The detent is also different in that it is shaped like an "L" with the longer arm being that portion containing the locking detent with its tiny gold unlocking spring, and the shorter arm containing a pin pallet which locks on the teeth of the escape wheel. These mechanisms each pivot under three separate bridges. One bridge secures the balance wheel, balance spring, and jewel release pallet. Another bridge secures the "L"-shaped detent with its hair spring. And the third bridge secures the tiny escape wheel. The escapement also has a one-half second beat, a bit of an oddity for a spring balance escapement, to me anyway. Of further interest in this escapement is its double over-coil balance spring. See Figures 2A and 2B for two views of the movement.

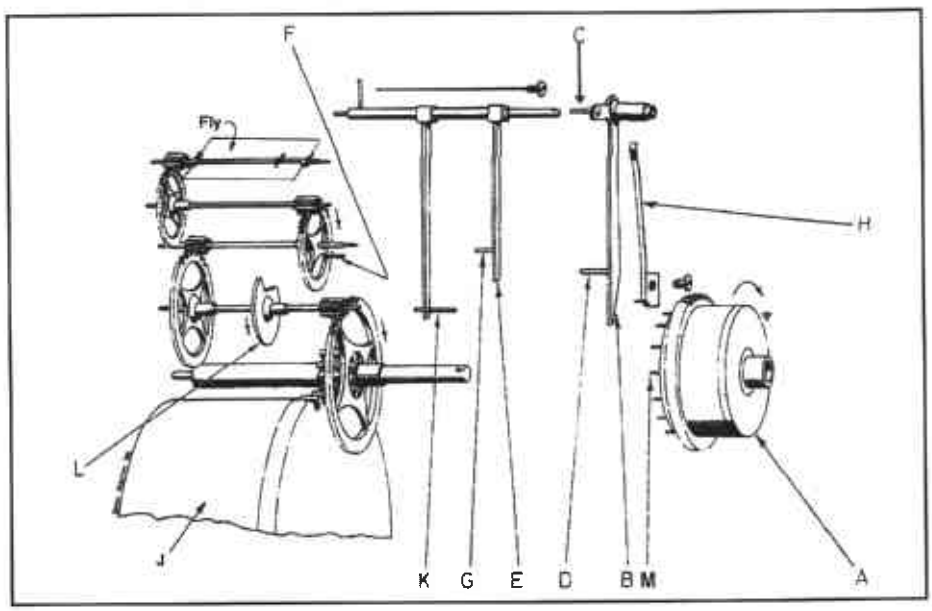
THE REMONTOIRE

The escape wheel receives a constant but controlled amount of power via an auxiliary spring (remontoire spring) which is rewound every 30 minutes by the main going spring, via the remontoire. Actually, it's my understanding that the term remontoire is an English word derived from the French word "remontoir," meaning to rewind, which is taken from "Remontoir d'egalite," a French term meaning a rewinding mechanism. The remontoire was used by many early clockmakers, especially

those involved in the quest of a marine chronometer by which longitude could be determined, namely Berthoud, Burgess, Burgi, Harrison, Huygens, and Mudge. The fluctuations in power that were produced by winding springs could be nearly eliminated by the remontoire. The fusee also provided a similar remedy, and the reader will find many cases where the two systems were used in unison, as in John Harrison's marine chronometers, as well as some produced by LeRoy and Berthoud. It's also my understanding that some strike trains were equipped with the remontoire, and I assume this was to control the speed of the strike/chime.

In transferring power from the mainspring or weight to the escapement, the main going spring, in this case, doesn't actually provide its power directly as it does in most clock movements. Instead, the mainspring only provides the power to "rewind" a much smaller auxiliary (the remontoire) spring via a system similar to that of a strike train (Figure 3). The remontoire power spring (A) is contained in a geared barrel that also has pins protruding out the back, and is wound ever 30 minutes by the main going spring (J). The power from the remontoire spring is then transmitted to the escape wheel via a gear train which is not shown in the diagram. To accomplish the rewinding of the remontoire spring, a train of wheels similar in function to those of a strike train is used. The remontoire spring barrel (A) has a number of pins (M) protruding out of it. As the remontoire spring barrel rotates, releasing power to drive the escape wheel, one of its pins (M) engages lever (B), pushing it to the right. As the lever (B) is pushed to the right, the warn lever (C) is lowered to block the path of the fly, and the stop-release lever (G) is being pushed to the right to release the stop-release pin (F), and the cam lock pin (K) is being raised to clear the notch in the cam. Eventually, the pin (M) rotates far enough around to release lever (B), lever (B) gets pushed back to the left by spring (H), releasing the fly and the rest of the remontoire train. The main going barrel (J) then drives the remontoire train until the locking cam (L) has made one revolution. When the locking pin (K) drops into the notch in the locking cam, the stop-release pin (F) is captured by (G) and the motion of the train is arrested. It takes the escape wheel 30 minutes to use up enough power to allow the remontoire spring barrel (A) to rotate enough for the next rewind to occur. Therefore, the power being provided to the escape wheel is generated from the same portion of the remontoire spring, providing a constant and consistent amount of power.

Figure 3. Diagram of the remontoire mechanism.



COURTESY/JOHN MARTIN, SEVENOOKS, UK

THE UP-DOWN WIND INDICATOR

While many of us have worked on clocks equipped with winding stops mounted on the winding squares or gear-driven up-down wind indicators, I had never seen either in the configuration of those that are in this clock.

On many finer clocks, and on factory clocks having huge mainsprings, the amount of power being released from the mainspring is somewhat regulated by winding stops. With winding stops, the power provided by the spring eliminates the large increase and decrease of power normally found when the spring is fully wound and in the last stages of the spring unwinding. On weight-driven clocks these winding stops prevent the weights from dropping too far down, or being wound up too high. And on some clocks there are dials which indicate the amount that the spring is wound, or in the case of a weight-driven movement, the amount of drop remaining. These little mechanisms are a source of much frustration to repairers who are not familiar with their setup. All of the winding stops and wind indicators that I've had the occasion to work on have been rather basic in design and usually are made of two or four parts. Quite simple to deal with really, once one becomes familiar with them.

However, this chronometer carriage clock by Berthoud has a most unique way of dealing with these two functions. On this clock, the wind indicator is operated by a

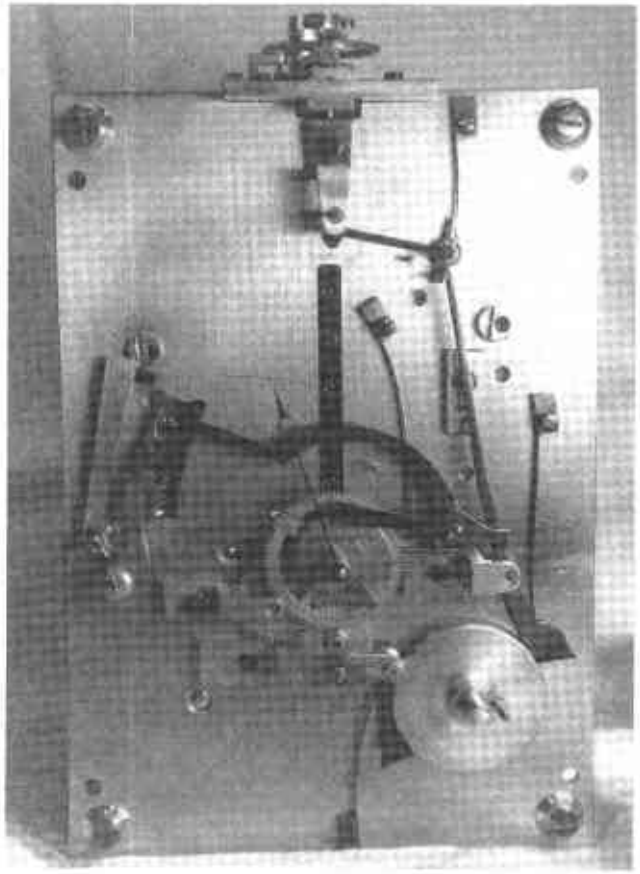
brass disc located on the arbor of the going barrel (Figure 4). The disc has two triangular-shaped steel wedges positioned on each side of it. The pointed ends of these wedges face away from the movement, and the angled faces are against the brass disc. When fully wound, the disc travels away from the movement, towards the back of the dial plate, allowing the wedges to move inward toward the center of the disc. One of the wedges has an arm leading away from it, the end of which has gear teeth cut into it. As the wedge moves, this arm is moved in or out and the geared teeth on it drive a pinion which is itself affixed to an arbor on which the indicator hand is affixed. And, as the going spring barrel winds down, the brass disc is brought back towards the movement, therein forcing the wedges further apart and rotating the dial hand counterclockwise, indicating less time remaining in the power of the mainspring. To protect the delicate wind indicator hand, its arbor is provided a coiled hair spring so as to maintain positive contact with the geared arm from the wedge.

As the going spring unwinds, the wedge that I haven't spoken too much of yet drives another lever. One end of this lever is pushed up and down with the movement of the wedge. On its opposite end, there is a paw which, when the going spring lets down to a predetermined amount, grabs hold of a notched cam located on the seconds bit arbor, therein stopping the seconds arbor from further rotation and stopping the functioning of the train that transfers power to the escapement.

PROBLEMS FOR THE REPAIRER

As mentioned earlier, I had no previous experience with a clock equipped with these specific types of mechanisms. When it came to my shop, the main problem seemed to be that the winding of the remontoire spring was not stopping after the one revolution, thus over winding the auxiliary/remontoire power spring. Upon disassembly, it was found that the #4 arbor had broken just inside the wheel mounting collet. It was also noted that the wheel on this arbor had sustained damage to its gear teeth. Assuming that this was the source of the problem, a replacement arbor and wheel assembly were made. But when the replacement pinion arbor and wheel assembly were installed, the problem persisted. This called for a close examination of the action between the wheels, cam, fly, and levers. And it was found that they were not functioning correctly. It was also found that a stop pin had been placed on the outside of the back plate to restrict the amount of return on the lifting lever. In effect, this pin was performing the function of the unlocking lever, and causing the other levers to be out of their intended positions for stopping the rotation of the train as the maker had intended. After many hours of monitoring the actions of mechanisms, disassembling the movement, adjusting the levers, reassembling the movement, and more monitoring, it became apparent that some previous repairer had also modified the levers. Therefore I straightened all of the levers, re-secured them to their arbor and tried again. Then came a series of minute adjustments to the arbors to make a proper function between them and the cam, wheels, and the lifting pins of the auxiliary spring barrel. But the problem persisted. Finally, I questioned why lever B was staked hard onto the arbor carrying levers E and K. So, I removed lever B and broached the collet out so that it would fit loosely on its arbor. This did the trick. Since it had come to me with a tight fit on that arbor, I erroneously assumed this to be the

Figure 4. The front view of the chronometer carriage clock.



way it was intended. However, it took many hours to find this last problem, then a matter of a few minutes to finally put it right.

My purpose for explaining the difficulties of repairing this movement is to point out to owners, collectors, and repairers the importance of not modifying the mechanisms in their clocks, and to encourage them to seek out and patronize dedicated and able repairers. With this clock, it seems like every repairer who worked on it did so with half measures and quick fixes. Each resulted in contributing to an even greater problem. And to undo those ill-made modifications ended up requiring a great deal more time than most commercial repairers would have been financially able to commit to it. In its prior condition, its value as a collectable object of horology was greatly reduced, besides making it a clock that other collectors would have been less inclined to acquire. I wish I could report that the ailments of this clock were the exception rather than the rule. But, for my small repair practice to get so many of these types of clock problems suggests that our clock repair industry is seriously wanting for dedicated and able repairers, those earnestly striving to maintain the integrity of the original clockmaker's intentions.

Now that this Berthoud chronometer carriage clock is functioning properly, it is back again with its owner. I have learned a great deal about some interesting clock mechanisms and become better acquainted with the Berthouds —a fascinating family of eighteenth and nineteenth century horologists.

Acknowledgement

I would like to thank the owner of this clock for assistance in describing the clock's history.

About the Author

Ronald K. Reed is the proprietor of a small clock repair business where he specializes in fine antique clock repairing; appraising for insurance, tax, and estate purposes and assisting collectors and estates in liquidating their collections. Mr. Reed is a graduate in civil engineering, spending over 35 years in the heavy construction industry. He is a member of NAWCC, AHS, and AWI, an associate member of BHI, and is the president of NAWCC Southern California Chapter 4.

EXHIBITIONS ON TIME

The Bruce Museum of Arts and Science, Greenwich, Connecticut, is celebrating the Millennium with two interrelated exhibitions on time:

November 13, 1999 through April 2, 2000
Marking Time
This family oriented exhibition will use an interactive approach to examine the concept of time and the action of timekeepers from biological clocks to water clocks, sundials and pendulums, from ancient calendars to Einstein's theory of time.

December 18, 1999 through March 19, 2000
The Art of Time
This exhibition will use art and artifacts to show how methods of sensing and measuring time have evolved as a result of human ingenuity and the needs of society. Ancient instruments, paintings and models will show the recording of days, months and years by the movements of celestial bodies. Clocks, watches, images and other artifacts will demonstrate the role of society in the refining of timekeeping. Artists' interpretations will illustrate the elusive nature of time.

The exhibition is part of the Greenwich 2000 celebration linking Greenwich, Connecticut, to Greenwich, England, "Where Time Begins." For further information please contact Marianne Smith at Bruce Museum tel: 203 869-6786 ext. 334 or by e-mail marianne@brucemuseum.com.