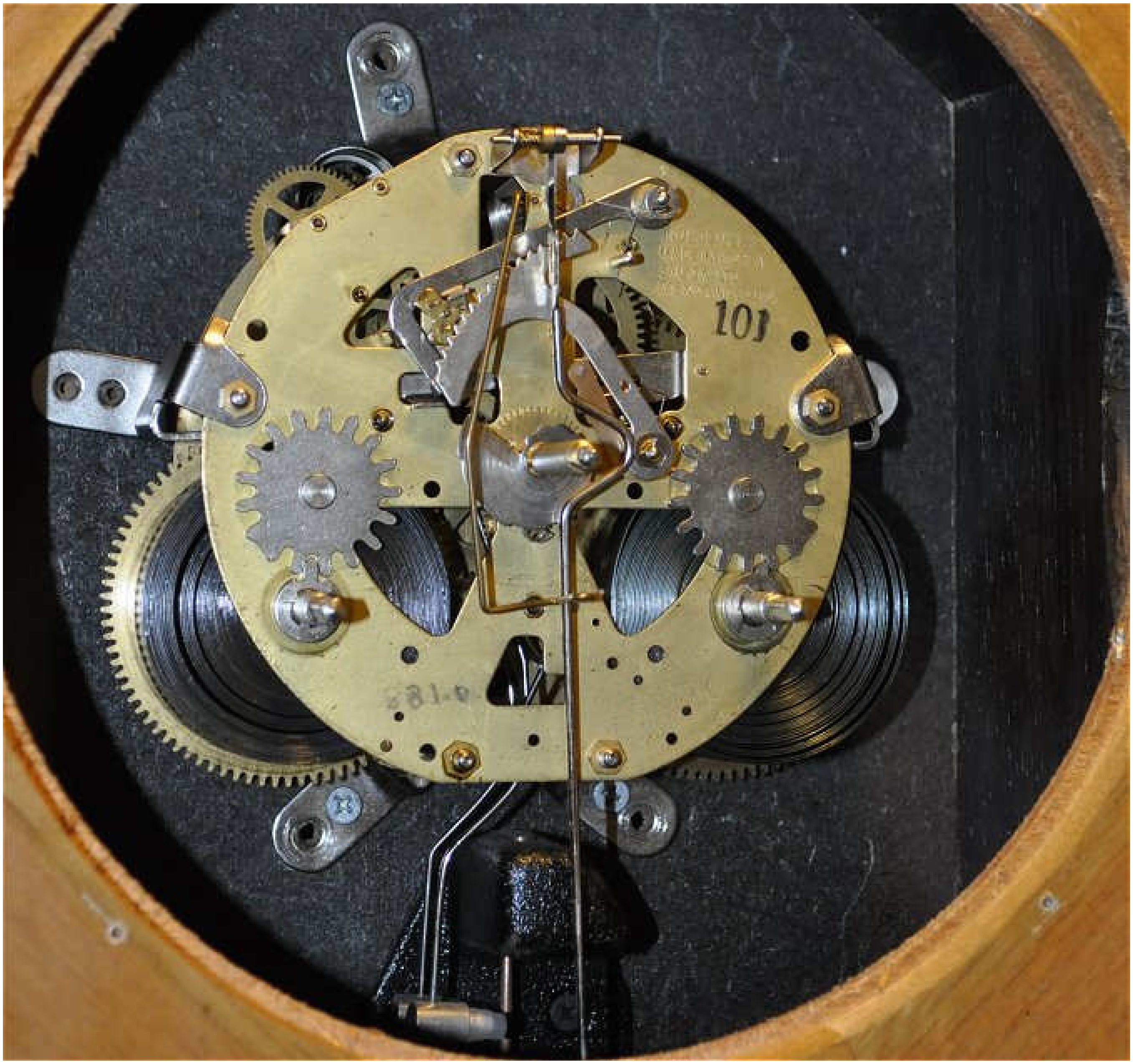
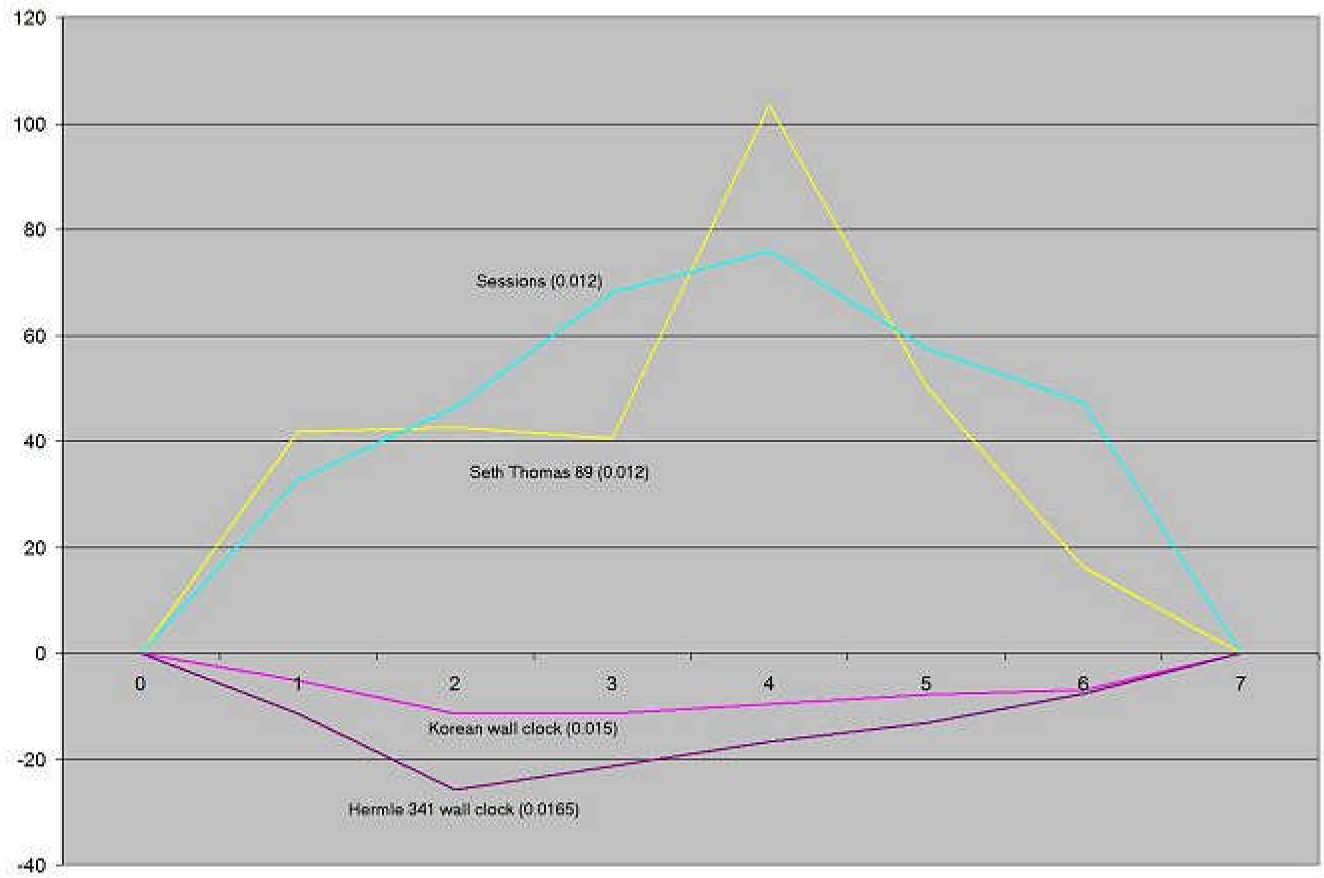
A Tribute to a Korean Clock

In the early 1990s, I saw many Korean and Japanese clocks that came in for repair. The appearance and design of the mechanisms were different when compared to European and American clocks, were difficult to repair, had design problems in the strike mechanism and problems with the grease used on the mainsprings, but these clocks from the Orient offered above-average timekeeping. The clock I saw most frequently had the Korean mechanism in the photo below in a school-house style case, sold by Montgomery Ward in the late 1970s. This clock kept accurate time and I wanted to know why.



This particular clock does not say "Montgomery Ward" on the dial, but it has the same mechanism. It has a semi-deadbeat escapement because the locking faces of the pallets are not curved, so a small amount of recoil does take place. The clock also has mainsprings that are 3/4" wide, similar to American clocks, so I wanted to compare my Korean clock to my Seth Thomas 89, which also has a semi-deadbeat escapement. Let me quote from a previous essay: "It is worth mentioning that the Timesavers catalog has a 3/4 x 0.015 x 170 inch mainspring for Japanese and Korean 31 day clocks from the 1970s and 80s, because some of their mechanisms look like copies of American clocks from the early 1900s. A 0.015" mainspring, when installed in a Seth Thomas 89, should have a calculated length of 169", and it would have 58% of the strength of a 0.018" mainspring. They were obviously onto something there." I believe that clocks from the Orient were different when compared to American and European clocks because the

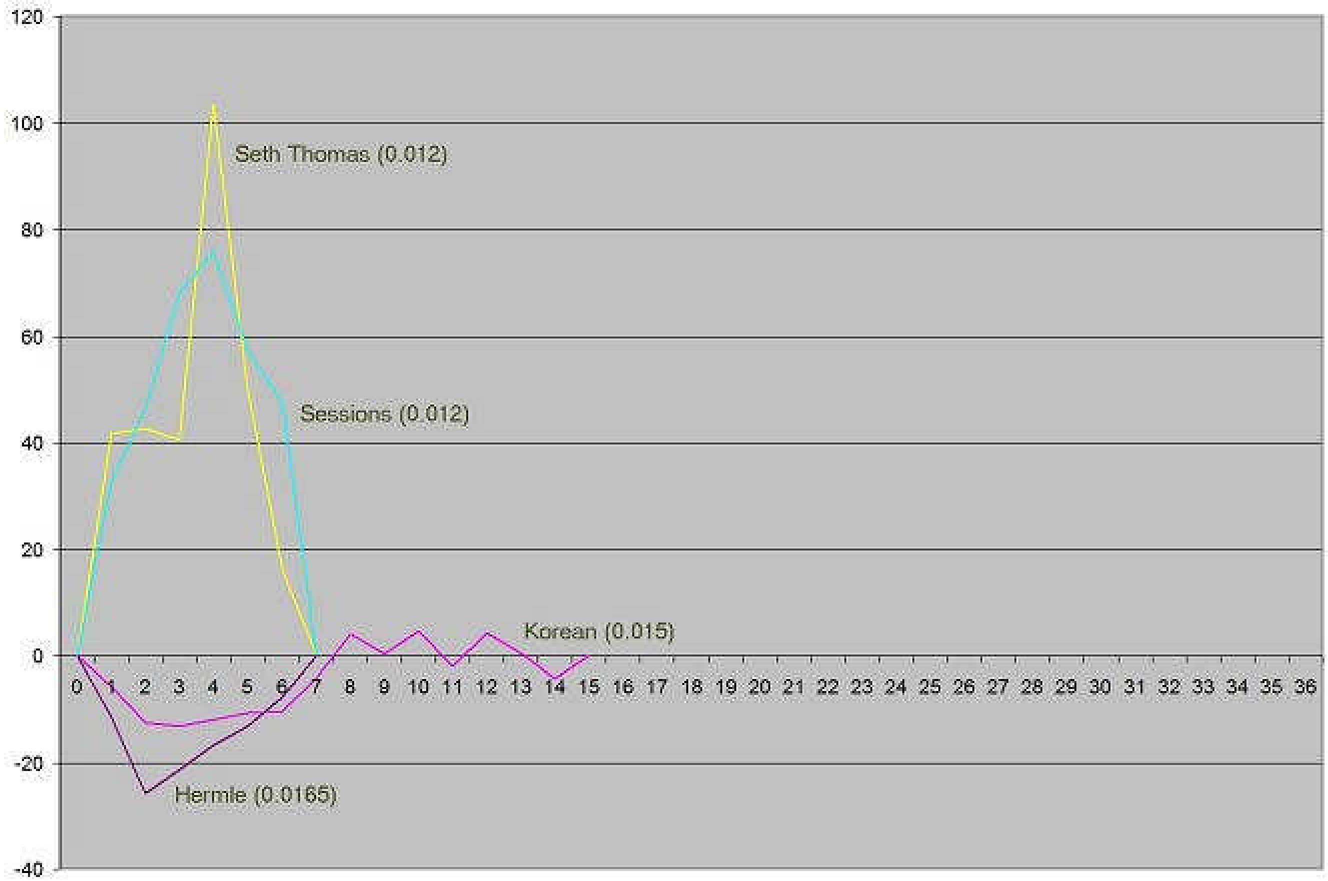
oriental clocks were designed by engineers and not clockmakers.
The data confirmed my belief that the Korean clock would be more accurate. However, the data for the Seth Thomas 89 was somewhat irregular, revealing that the mainspring was not the best, so I included the data for two other clocks from my previous essay for comparison. On all the graphs, days one through seven are shown on the horizontal line (X axis). The timekeeping error in seconds is shown on the vertical line (Y axis). Click on each image to see the graph in full size.



A factor that makes the Korean clock last for a whole month is the open barrel. The Hermle 341 would perform better if it had a larger mainspring barrel like the more expensive Hermle 351 or, better still, an open barrel like most American and oriental clocks. The accuracy of the Hermle clock could probably be improved by replacing the mainspring with another German mainspring from a different manufacturer if the Hermle clock was made before the 90s. The 0.0165" mainspring in this experiment was not a Hermle mainspring. I would not recommend such a strong mainspring: you should use 0.015" or less.

There was more to learn by continuing the test. This clock ran for 36.5 days, and the graph looked like the one below. After six days, the mainspring begins to show modest irregularity. By the end of the month, we can see a curve that reaches a bottom after 15 days.

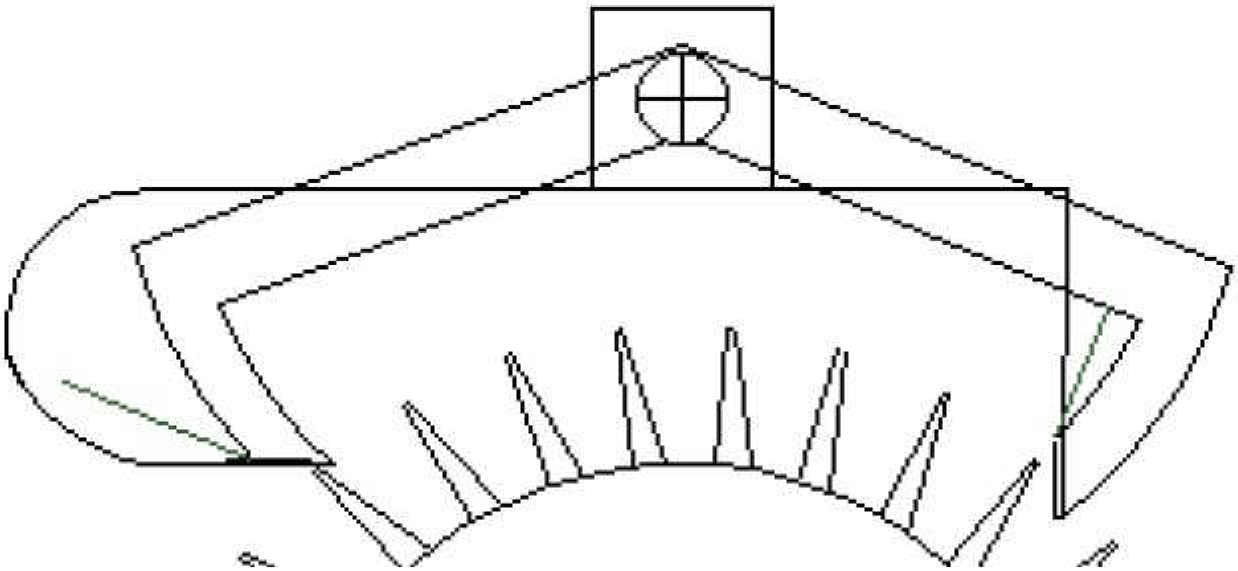
Considering a normal 31 day run, an overall error of 75 seconds over 31 days is very respectable for a spring-driven clock. This clock lost 5 seconds per day during the first half of the month, and gained 5 seconds per day during the second half of the month. Few clocks can match that performance. The clock could be made more accurate by winding it twice a month. The overall error would be reduced from 75 seconds to 13 seconds.



The data for the 31 day clock shows more clearly than for the other clocks how accuracy can be improved by winding the clock twice per cycle. If you have a clock which you wind once a day, wind it twice a day. If you have a clock which you wind once a week, wind it twice a week. If you have a clock which you wind once a month, wind it twice a month. Every time you wind your clock, move the minute hand a minute or two to the correct time.

Comparing the curve for the Hermle clock to the curve for the Sessions clock, you can see that the Graham escapement in the Hermle clock loses time during the first half of the cycle, whereas the recoil escapement in the Sessions clock gains time. The locking face of the Graham escapement has an angle of 0º so that there is no recoil. The locking face of the recoil escapement is the same as its impulse face, which should be 45º. Therefore, clocks with mainsprings could have their variable error reduced by making a Graham escapement with a locking face which includes some recoil, with an angle of 22º, for example. This would almost eliminate the variable error caused by the mainspring and bring the curve close to the horizontal axis.

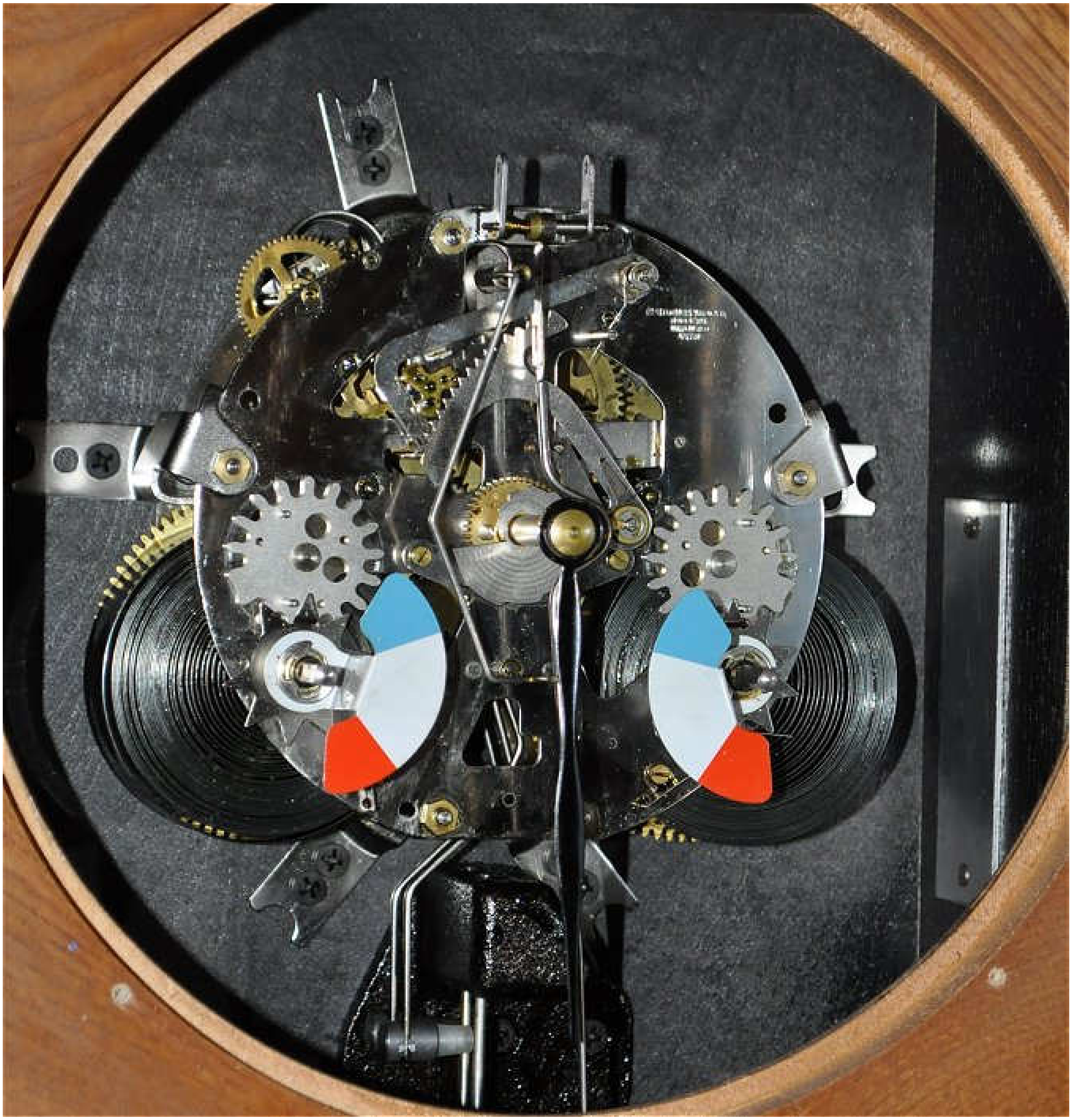
The image below has the recoil escapement superimposed over the Graham escapement with an added line on each side to show a possible locking face for a Graham escapement with some recoil.



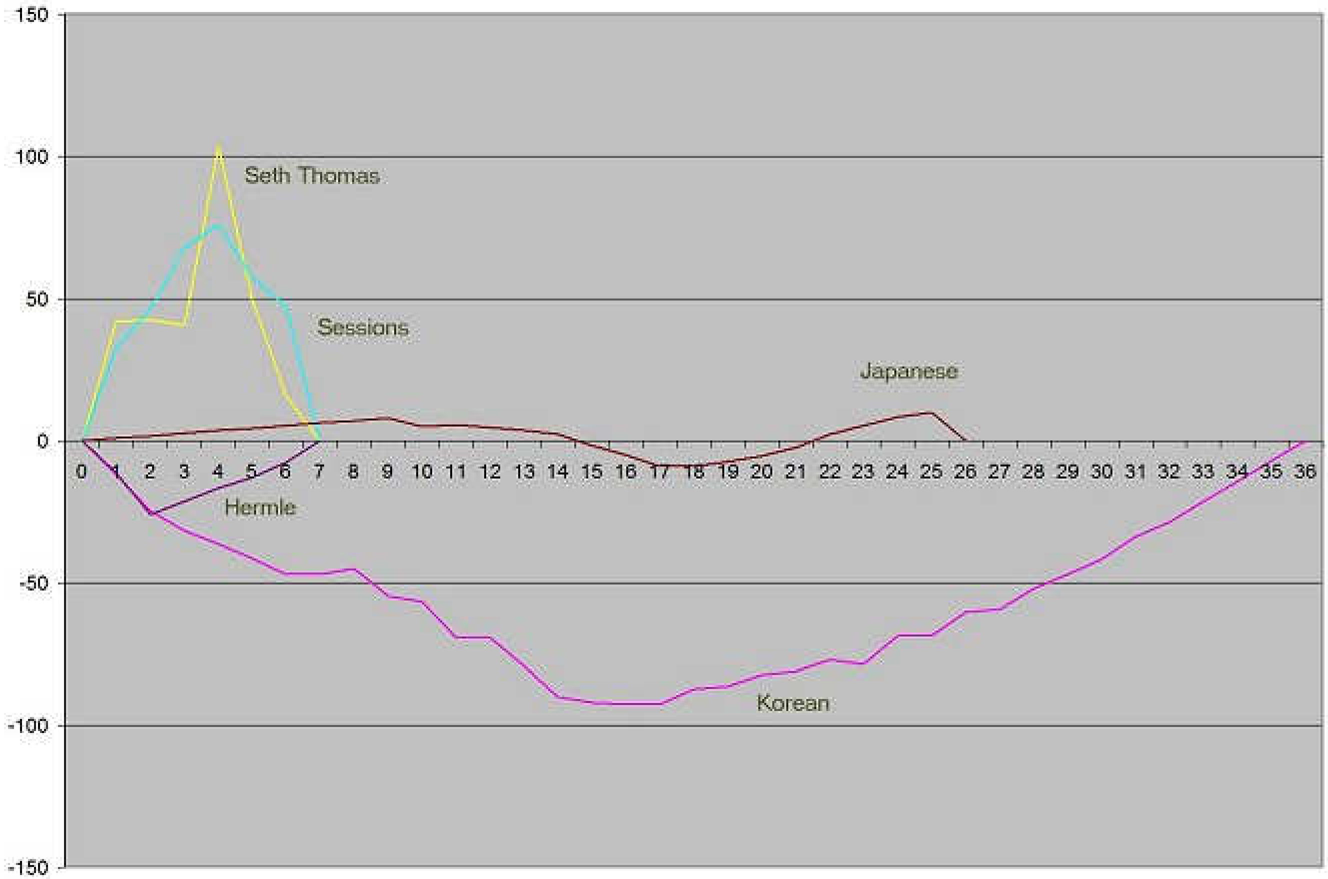
Since a clock gained more time with the recoil escapement than a clock lost with the Graham escapement in the first half of the cycle, an angle of less than 22º would be needed, such as 10 or 15º. As shown in my previous essay, using a stronger mainspring affected the accuracy of both the recoil and the Graham escapements, so the optimal angle of the locking face on the Graham escapement would also depend upon the strength of the mainspring. Using a stronger mainspring would require a smaller angle for the locking face.

The Korean and Japanese mechanical clocks that I repaired in the early 90s were considerably more accurate than virtually all the other spring-driven clocks that I repaired at that time, with few exceptions, yet they were by far the cheapest mechanical clocks available in the 1970s and 80s. Many customers said their Japanese clocks had run for as long as 25 years, whereas the average Hermle needed an overhaul after about 12 years, and some after only 6 years. The Korean and Japanese mechanical clocks were also better than the Chinese mechanical clocks I have seen that came later.

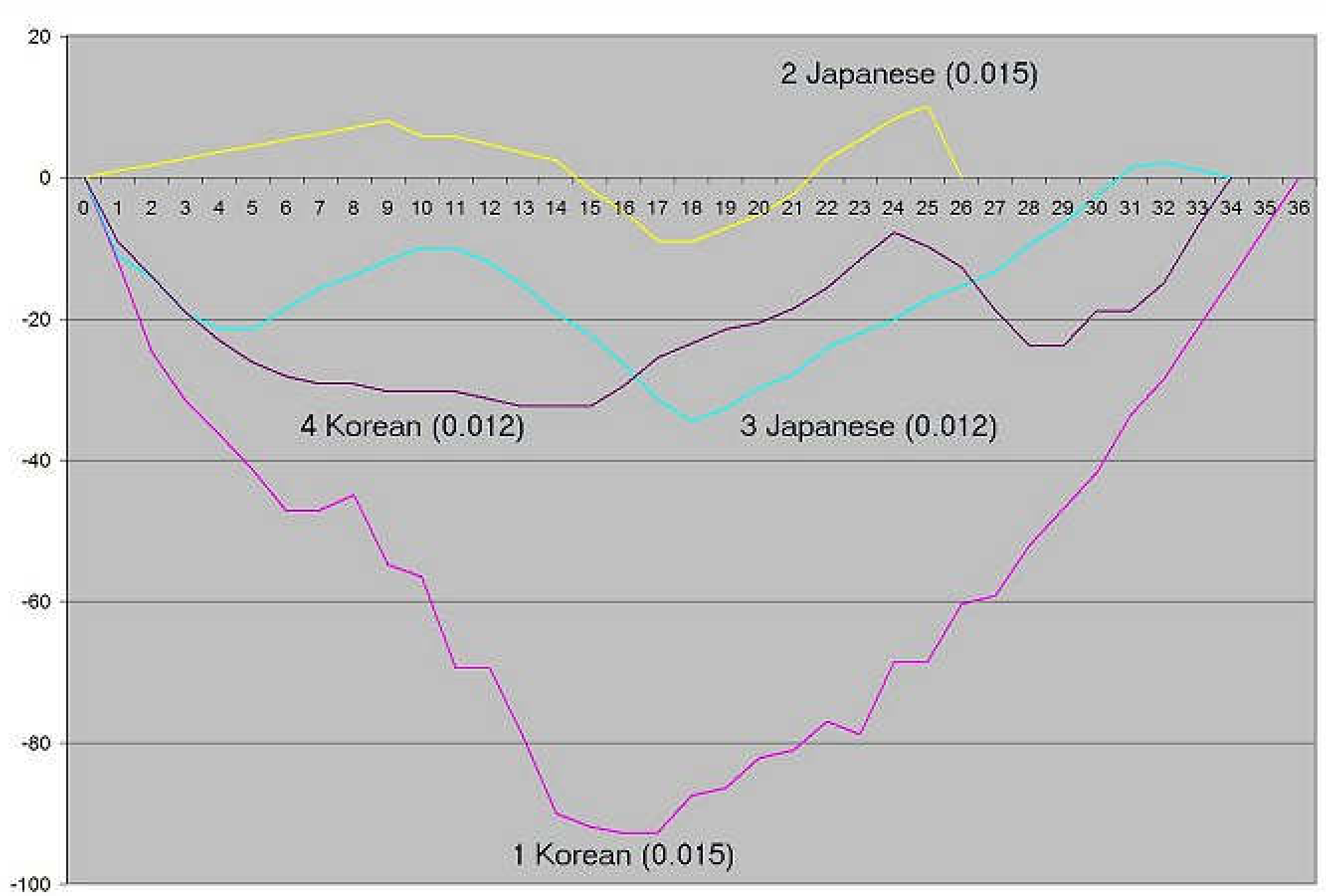
And now, finally, a Montgomery Ward clock made in Japan! This clock has stopworks and wind indicators, and appears to be chrome plated. It is a high-mileage clock with a lot of wear, having served its owner reliably for many, many years. It was probably made in the late 1960s.



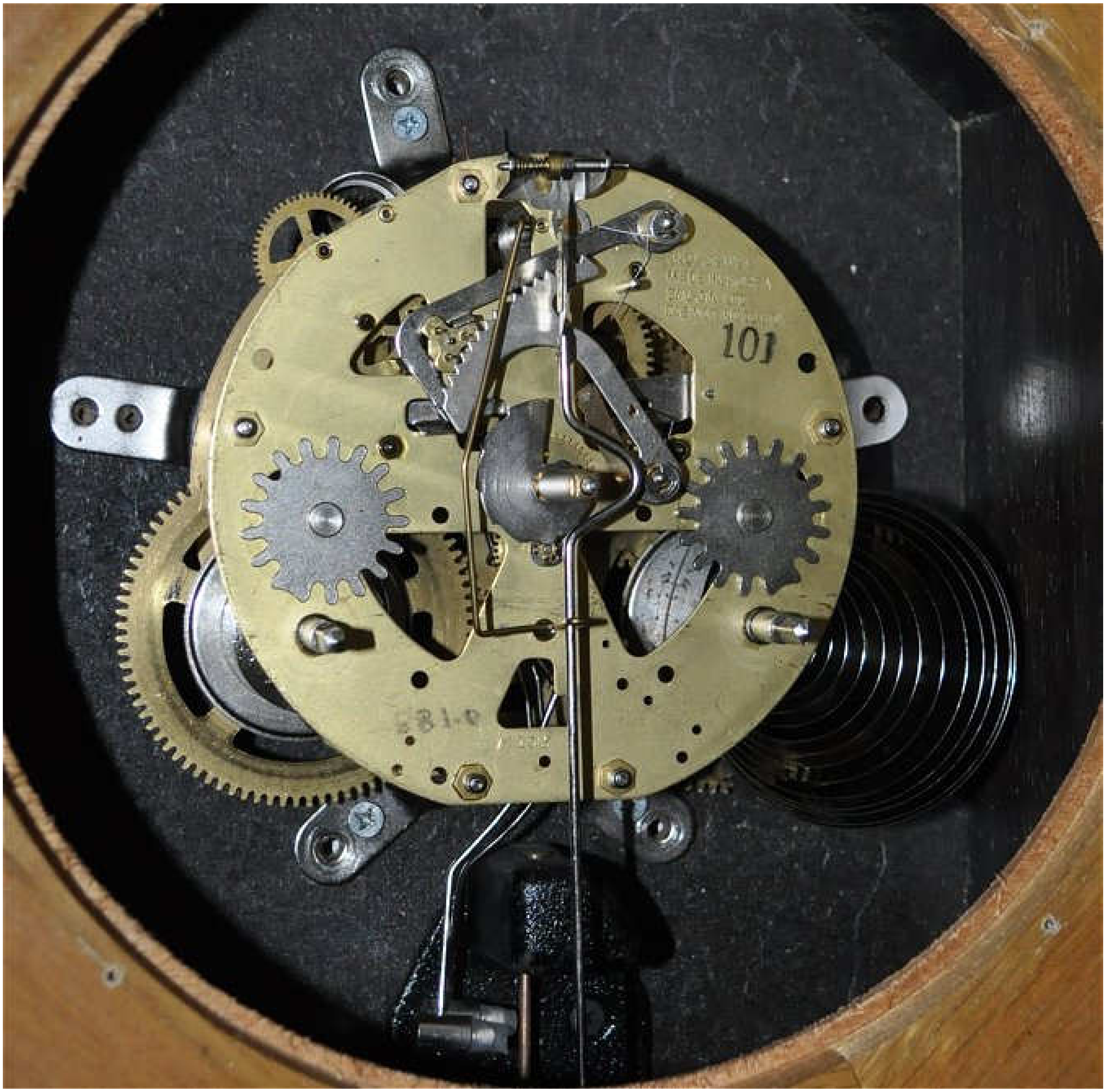
The Japanese clock stopped after 26 days.



Update: The new replacement mainspring showed a similar curve, reaching a bottom on the 18th day, comparing lines 2 and 3 in the graph below, suggesting that the variation was more likely caused by the escapement instead, possibly in a longer term trend line. Whereas the old mainspring was 0.015" thick and 170" long, the new mainspring was 0.012" thick, with only half the strength, and was only 70" long. I decided to try it because my spreadsheet for mainsprings calculated that I would get almost 26 turns with the old mainspring, and 23 turns with the new one, so the difference would be small. I polished the pivots of the escape wheel and the fourth wheel, replaced the mainsprings and one bushing. The Japanese clock ran for 34 days with the new mainsprings, (though the strike stopped after 25 days).



With the new mainsprings, the Japanese clock had a maximum variable error of 35 seconds on the 18th day, shown in line 3, or a variable error of about 2 seconds per day. Between the 18th day and the 30th day, the clock gained about 3 seconds per day. Line 4 shows the performance for the Korean clock with new 0.012" mainsprings, which raises more questions than answers because it is more similar to the lines for the Japanese clock rather than Line 1. The data show that by lowering the mainspring strength by 50% will lower the variable error in the timekeeping by at least 50%. Furthermore, the duration of up to 36 days is not affected by the mainspring length by much, shown by replacing a 170" long spring with a 70" long spring. The duration is much more affected by the size of the mainspring barrel, or the amount of space the spring has available to expand in. The photo below shows the Korean clock with the new 0.012" mainsprings. The strike mainspring is fully wound, and barely visible. I left the time mainspring unwound for the photo, so that you could see it.



The semi-deadbeat escapement in the Korean and Japanese clocks was more accurate than all the others because there was a small amount of recoil to offset the variation in the Graham escapement, and the small amount of recoil was symmetrical (the same) for both the entry and exit pallets. While the semi-deadbeat escapement in the Seth Thomas 89 was more accurate than a recoil escapement, it was less accurate than the Graham escapement in the Hermle clock. The recoil in the escapement of the Seth Thomas 89 was not the same for both pallets, resulting in greater variation in timekeeping. Everything in the Korean and Japanese clocks was designed to keep manufacturing costs as low as possible, and keeping costs to a minimum is evident in the design of the pallets. Finding nothing in the clock or the pendulum that suggests an effort to make a superior timekeeper, the conclusion has to be that the superior accuracy was coincidental.

Studying the Korean and Japanese clocks on this page revealed more information than any previous experiment. The only mechanical clock I ever had which kept more accurate time than this Japanese clock was a Self-Winding Clock (ca. 1910) with a 39" mercury-compensated pendulum and a total error of 20 seconds per month. Another clock which performed similarly was my Hermle 1161 grandfather clock with its 39" non-compensated pendulum, but this clock did not have mainsprings. My Herschede never came close.

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