Decrypting How to Use a 120-Year-Old Aviation Watch

By Ken Glace

This is a story involving a watch, aviation history, horology (the study of time and its measurement) and a forgotten technique for recording time.

The story starts with the acquisition in 1984 of the watch pictured. At the time, all that was known about it was the timepiece was from the WWI and that it was a pilot's watch. The watch carries only two distinctive marks, both on the movement. One is a serial number (5831) and the other is a Swiss cross.

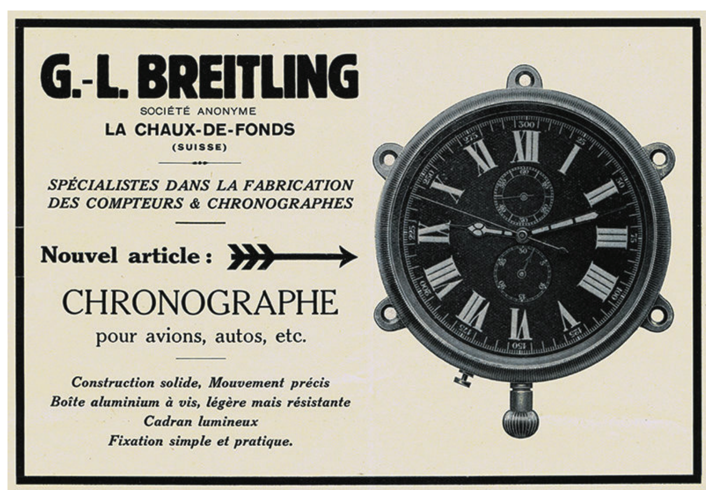
At first glance, it is a fairly ordinary pocket watch, but two smaller dials (called subdials) and two seconds hands indicate that this watch has a "chronograph" capability. In non-horological terms, the watch both keeps time and acts as a stopwatch, to record periods of elapsed time. The lower subdial indicates the seconds connected to the time and the upper subdial counts the number of full minutes measured by the chronograph. The chronograph is started, stopped and reset by pressing the crown at the top of the watch, which also winds the watch. The watch's timekeeping is set by depressing a small button just visible on the edge of the case, opposite the 11.

The large seconds hand measures the chronograph's seconds and this was where the mystery started. Note that this hand runs along a scale that runs from 0 to 300. It did not take long to ask what this scale measured, and it was this question that took nearly 30 years to find the answer.

The mechanism of the watch, called the "movement" by watchmakers. Note the extra mechanical complexity of the watch added by the chronograph's functions.

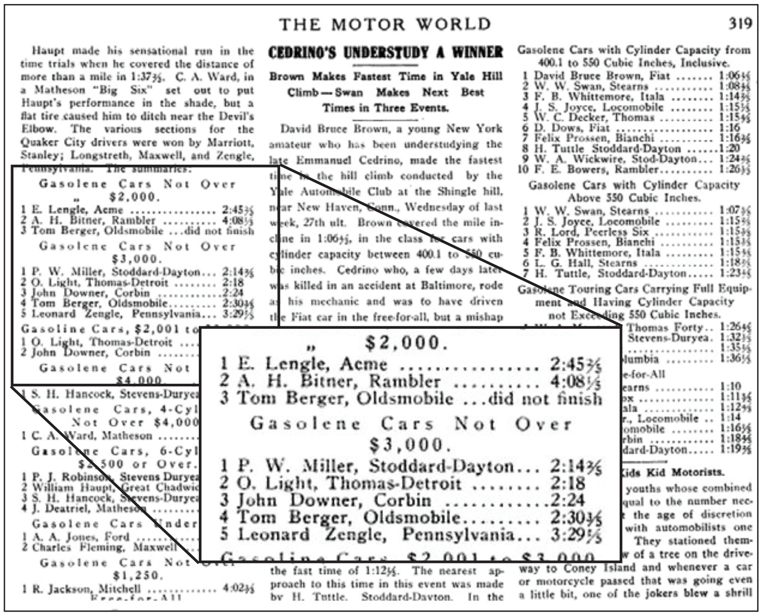
The obvious path was to start asking the professionals about this. However, every major watch collecting organization and every watchmaker queried between 1985 and 2018 could not come up with an answer. They did comment on what it wasn't measuring. It was not a tachometric scale, one that allows a chronograph to directly calculate speed or distance based on elapsed time[1]. Nor was this any of the scientific scales, such as "pulsometer" used by doctors to read the pulse rate of patients, or a "decimeter" which allowed a direct reading of hundredths of a minute.

Even after the internet became popular, repeated internet searches over a period of 15 years failed to turn up anything other than more people asking the same question, but no real answers were available.



A reproduction of a period advertisement of a competitor's watch. Courtesy Google Archives

This problem remained unresolved until the first clue was uncovered in 2018. A friend noted that 300 divided by 5 is 60, which, obviously, is the number of seconds in a minute. That correlation was a bit confusing until remembering that watches during the early 20th century ran their escapements at 300 beats per minute (the rate that the watch ticks and tocks). After a little bit of mathematical confusion about how to apply that fact to this scale, it was determined that the chronograph scale was



THE MOTOR WORLD 319

Haupt made his sensational run in the time trials when he covered the distance of more than a mile in 1:37 3/5. C. A. Ward, in a Matheson "Big Six" set out to put Haupt's performance in the shade, but a flat tire caused him to ditch near the Devil's Elbow. The various sections for the Quaker City drivers were won by Marriott, Stanley; Longstreth, Maxwell, and Zengle, Pennsylvania. The summaries:

Gasolene Cars Not Over $2,000.

1 E. Lengle, Acme 2:45 3/5
2 A. H. Bitner, Rambler 4:08 1/5
3 Tom Berger, Oldsmobile ...did not finish

Gasolene Cars Not Over $3,000.

1 P. W. Miller, Stoddard-Dayton... 2:14 3/5
2 O. Light, Thomas-Detroit 2:18
3 John Downer, Corbin 2:24
4 Tom Berger, Oldsmobile......... 2:30 4/5
5 Leonard Zengle, Pennsylvania... 3:29 1/5

Gasoline Cars, $2,001 to $3,000.

1 O. Light, Thomas-Detroit
2 John Downer, Corbin

Gasolene Cars Not Over $4,000.

1 S. H. Hancock, Stevens-Duryea

Gasolene Cars, 4-Cyl Not Over $4,000

1 C. A. Ward, Matheson

Gasolene Cars, 6-Cyl $2,500 or Over.

1 P. J. Robinson, Stevens Duryea
2 William Haupt, Great Chadwick
3 S. H. Hancock, Stevens-Duryea
4 J. Deatriel, Matheson

Gasolene Cars Under

1 A. A. Jones, Ford
2 Charles Fleming, Maxwell

Gasolene Cars Not Over $1,250.

1 R. Jackson, Mitchell 4:02 3/5

Free-for-All

CEDRINO'S UNDERSTUDY A WINNER

Brown Makes Fastest Time in Yale Hill Climb—Swan Makes Next Best Times in Three Events.

David Bruce Brown, a young New York amateur who has been understudying the late Emmanuel Cedrino, made the fastest time in the hill climb conducted by the Yale Automobile Club at the Shingle hill, near New Haven, Conn., Wednesday of last week, 27th ult. Brown covered the mile incline in 1:06 4/5, in the class for cars with cylinder capacity between 400.1 to 550 cubic inches. Cedrino who, a few days later was killed in an accident at Baltimore, rode as his mechanic and was to have driven the Fiat car in the free-for-all, but a mishap ... the fast time of 1:12 4/5. The nearest approach to this time in this event was made by H. Tuttle. Stoddard-Dayton. In the

Gasolene Cars with Cylinder Capacity from 400.1 to 550 Cubic Inches, Inclusive.

1 David Bruce Brown, Fiat 1:06 4/5
2 W. W. Swan, Stearns 1:08 4/5
3 F. B. Whittemore, Itala 1:14 3/5
4 J. S. Joyce, Locomobile 1:15 1/5
5 W. C. Decker, Thomas 1:15 4/5
6 D. Dows, Fiat 1:16
7 Felix Prossen, Bianchi 1:16 3/5
8 H. Tuttle Stoddard-Dayton 1:20
9 W. A. Wickwire, Stod-Dayton... 1:24 4/5
10 F. E. Bowers, Rambler.......... 1:26 1/5

Gasolene Cars with Cylinder Capacity Above 550 Cubic Inches.

1 W. W. Swan, Stearns 1:07 3/5
2 J. S. Joyce, Locomobile 1:15 4/5
3 R. Lord, Peerless Six 1:15 4/5
4 Felix Prossen, Bianchi 1:15 3/5
5 F. B. Whittemore, Itala 1:15 4/5
6 L. G. Hall, Stearns 1:18 2/5
7 H. Tuttle, Stoddard-Dayton..... 1:23 4/5

Gasolene Touring Cars Carrying Full Equipment and Having Cylinder Capacity not Exceeding 550 Cubic Inches.

Thomas Forty.. 1:26 4/5
Stevens-Duryea. 1:32 1/5
1:35 4/5
...lumbia 1:36 1/5

...e-for-All

...earns 1:10
...ox 1:11 4/5
...ala 1:12 4/5
...r., Locomobile .. 1:14
...omobile 1:16 1/5
...rbin 1:18 4/5
...dard-Dayton..... 1:19 3/5

...Kids Kid Motorists.

... youths whose combined ...qual to the number nec... the age of discretion ... with automobilists one ... They stationed them... of a tree on the driveway to Coney Island and whenever a car or motorcycle passed that was going even a little bit, one of the jokers blew a shrill

The page from the 1903 MOTOR WORLD *magazine, containing the race results reported in fifths of a second. (Courtesy Google Archives)*

directly measuring fifths of a second and reflected the ultimate accuracy of the watch.[2]

A second clue came in October of 2018 when a scanned copy was discovered of an advertisement from the early 1900s for a Breitling chronograph that was "pour avions, autos, etc.," which translates from French to "for planes, cars, etc." This watch also featured the 0 to 300 scale, confirming that this scale really was for measuring periods of time at the maximum possible accuracy capable by the timepiece and that pilots would be interested in using it.

While this confirmed the known information regarding this watch, it did not answer the question about how the watch was used. After pondering this, it was realized that maybe we needed to be looking for an outdated, forgotten technique of measuring and recording of time. With this insight, maybe the wrong question was being asked. Instead of asking "what is being measured" the question should be, "Why would someone measure time in fifths of a second?"

This was the big breakthrough, because when Googling "measure time in fifths of a second," an archive copy of the June 4, 1906 edition of *THE MOTOR WORLD* retrieved and is reproduced here. In that magazine there were automobile race reports that gave the results in minutes, seconds, and fifths of seconds. Further research indicated that all racing back in that era was reported in fifths of a second. This is logical, as this was the limit of scientific accuracy of the chronographs available at the time.

An examination of the finishing times at the first air race held in Reims, France, confirms the use of timing pieces configured like this watch. The Gordon Bennett Trophy consisted of two laps over a 10 km (6 mile) circuit, associated with this was the Circuit Prize for the fastest lap. Glenn Curtiss set the circuit record to 7m 55.4s, and then took the two lap Bennett Trophy a time of 15m 50.4s. Competing times are reported as 20m 47.6s, 16m 32.0s and 15m 56.1s (probably an error – most likely 15m 56.2s). Louis Bleriot managed to take the Circuit prize away from Curtiss with a time of 7m 47.4s. The interesting aspect about all these times (with one exception) is that they are all reported to the closest fifth of a second. Further, the Gordon Bennett Trophy winners for 1911 (Eastchurch, England), 1912 (Clearing, Ill.), 1913 (Reims, France) and 1920 (Orleans/Etampes, France) all are recorded to the closest fifth of a second.

Finally, the was the primary question answered: the scale was used to record the most accurate measure of laps times available with the existing during the first part of the 20th century.

But now a second problem presented itself: what was the practical use of the scale on this watch? Obviously, there had to be a way that this watch's scale made measuring fifths of a second easier, because why would anyone bother making an expensive watch if it didn't help make a job easier in some way?

The initial approach to trying to answer this question was playing around with converting decimals into fractions. That did not work. After about a month of contemplation, there came realization that a modern sense of computers and decimal seconds was being applied to a problem that was being solved without computers in a period when elementary fractional mathematics was common. Again, the realization was to go back to the basic issue, which was to determine how to use the numbers directly read from the watch.

The solution was easy, once the right thought experiment was applied. It goers as follows: Assume we had just measured a time slightly less than 30 seconds, with the second hand stopped at 148, as read directly from the chronograph scale. To convert this time to fifths of a second, all we need to do is a bit of simple subtraction that can be done on the watch dial itself. In this case we note that 29 seconds is 145 fifths of a second, so we take 148 (the measured time) and subtract 145 (which is 29 seconds) to get the fraction of a second between 29 and 30. Therefore: 148 – 145 = 3, which results in 29 and 3/5ths of a second. (Or, just simply count the number of tics from the 29 second mark to the second hand's position.)

And this was how it was rediscovered that this watch is a device designed to quickly determine race times down to a fifth of a second, and the design of the dial minimized the need for mental mathematics to determine that fraction. This was a fascinating look into the "nuts and bolts" of how early aviation performance was measured and recorded. It was also interesting to see how the available tools from a century ago were used to provide the maximum amount of precision in timekeeping. An interesting way to apply available technology in a "user friendly" way that fit the standards of the period.[1] ✈

End Notes

1 In case you are unfamiliar, a tachometer scale uses a "logarithmic" scale. Adding and subtracting logarithms performs the same mathematical function as multiplication of regular numbers, and this addition is the basis of all slide rules. In the case of a tachometric scale, the "logs" are used to determine speed over a set distance over a given time. Most often they are used to measure time it takes for something to cover a mile, to give miles per hour. The most obvious features of these scales are they count down with time and have a non-linier scale.

2 The "beat rate" of a clock is, basically, how fast it ticks. The most common beat rate of watches in the early 20th century was 300 beats per minute (BPM), or 18,000 beats per hour. This gives this chronograph an accuracy of plus or minus 0.2 of a second, since any time period less than this falls between the pulses of the escapement and cannot be meaningfully measured. Modern quartz watches run at 36,000 BPM, which is an accuracy of plus or minus 0.00003 of a second.