

THE DECIMAL REVOLUTION

STORY
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Everyday life, globally, has nearly always been structured in twelves. Based on 12 moon cycles in one revolution of the sun, we have 12 months in a year, 24 hours in a day, and so on; even a dozen eggs. We are accustomed to the number, and yet its use has been questioned, and some fascinating watches were made in the process

We have Ancient Egyptian astronomers to thank for duodecimal hours, dividing our days and nights each into 12 parts. These great scholars, working some 4,000 years ago, would observe 12 stars, or groups of stars (the constellations), rising at approximately equal intervals in the night sky, marking 12 months in a year. The ancient astronomers' 12-based system of time reckoning still orders our lives. The reasons for splitting each hour into 60 minutes, and each minute into 60 seconds, were just as practical and just as ancient. The so-called sexagesimal, or sexagenary, system dates to the Babylonian Empire and was chosen for its mathematical handiness. The number 60 can be divided by a lot of smaller numbers without leaving an inconvenient remainder. But the system always had its critics.

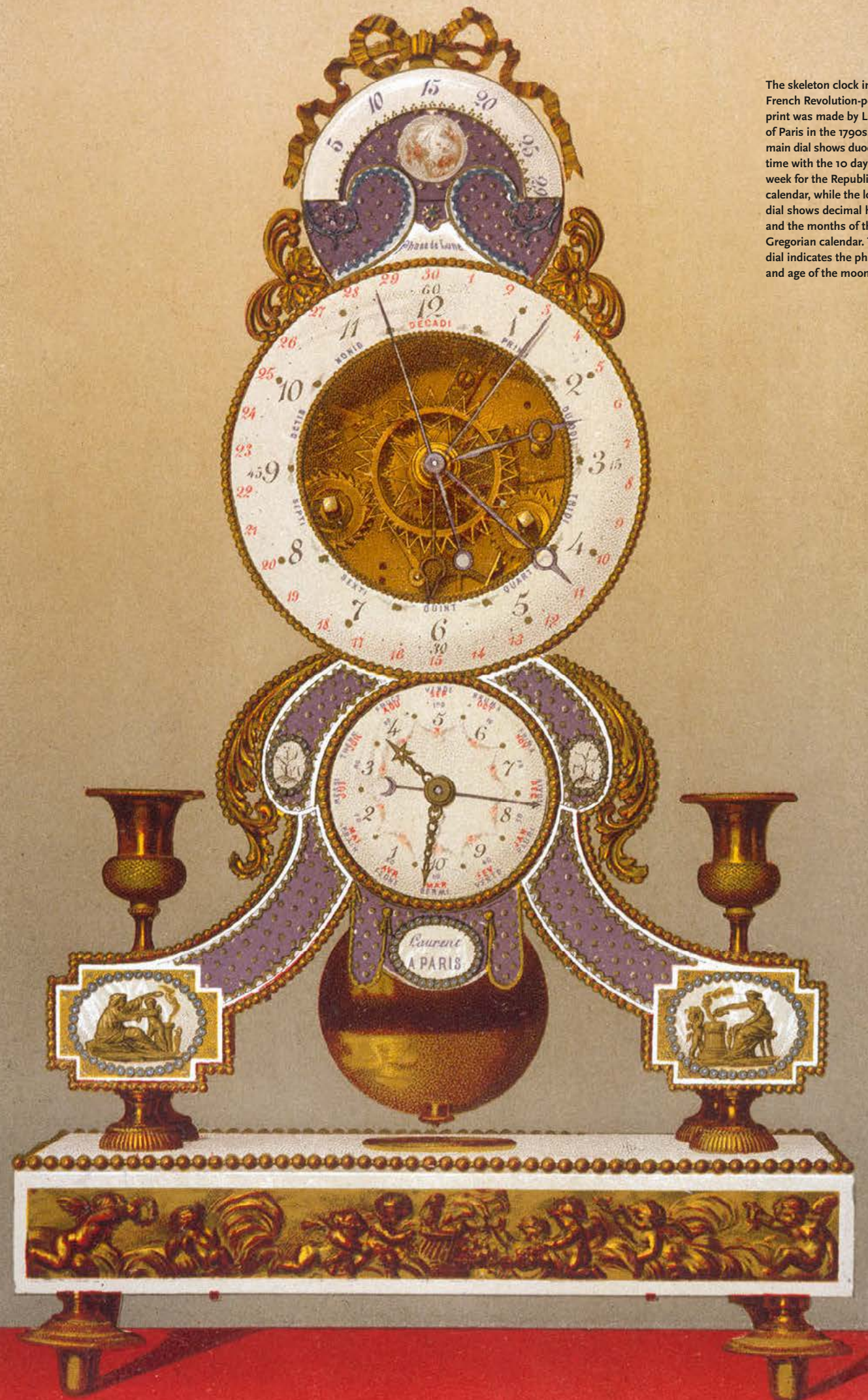
There was an alternative. From equally long ago, Egyptian and Chinese astronomers had used a decimal system of measurement in parallel with duodecimal and sexagesimal measures. As the demands of mathematical sciences became ever more complex in the centuries that followed, sexagesimal



Pocket watch with decimal hours, c. 1795, Inv. No. T-90

Time according to the decimal and duodecimal systems is displayed on this Geneva-made key winding pocket watch. The Arabic numerals indicate the duodecimal hours, one to 12, while the Roman numerals show the decimal

hours on the scale I-V. The duodecimal minutes are counted on the scale around the periphery of the dial and decimal minutes are on the inside scale. The 52 mm-wide Directoire-style case is made of silver, engraved, and numbered "3022"



The skeleton clock in this French Revolution-period print was made by Laurent of Paris in the 1790s. The main dial shows duodecimal time with the 10 days of the week for the Republican calendar, while the lower dial shows decimal hours and the months of the Gregorian calendar. The top dial indicates the phase and age of the moon



computation gradually became more of a liability than an asset, at least to specialists.

By the eighteenth century, voices for change had grown loud. In a treatise of 1769, the British mathematician, astronomer, and part-time watchmaker William Emerson (1701–1782) described the astronomical computation that still needed to be completed if we were to fully understand the movements of the heavens.

One of the hardest challenges was to plot the complex gyrations of the Moon. “It is a work of great labor to reduce all her motions to certain rules,” Emerson complained. “It would be much for the ease of calculation if the sexagenary account was laid aside, and the decimal one substituted in its room. For there are so many reductions in the one that make it exceeding tedious, which are entirely avoided in the other. But that tyrant Custom has already got possession of the former, and is likely to keep it.”

For 20 years, it seemed as if Emerson’s gloomy prediction about the staying power of the sexagesimal system had been true. Then in 1789, France revolted.

THE AMBITION HAD BEEN TO WREST ALL SCIENTIFIC MEASURE FROM THE TYRANNICAL HANDS OF CUSTOM

It took a few years for the revolutionaries to get around to changing the clocks, but it was part of the plan. The ambition had been to wrest all scientific measure from the tyrannical hands of custom. Time was the last of the old order to succumb to modernization.

In 1794, a revolutionary decree came into force commanding a return to the decimal notation of the ancients. “The sacred traditions of Egypt, which became those of all the East, brought the earth out of chaos,” proclaimed the decree. It went on, “The division of the hour into sixty minutes and of the minute into sixty seconds is incommodious for calculation and no

longer corresponds with the new division of astronomical instruments.” Henceforth, the Republican revolutionaries demanded that the day would be divided into 10 hours, with each hour comprising 100 minutes and each minute split into 100 seconds.

On the face of it, this must have been considered a boon for France’s horologists, who were among the best in the world. With Republican law on their side, a new system of time measurement for a country of some 29 million citizens might have looked to them like a business opportunity.

But the optimistic mood of progress soon soured. The problem with French Republican time was that theory and practice were in collision. In theory, it made perfect sense to divide the day using tens and hundreds rather than twelves and sixties. William Emerson had been right: sexagesimal calculations could be exceedingly tedious. But the practical challenges of changing time were immense.

Making a purely decimal timekeeper would be straightforward enough. But few French citizens could afford to abandon the

clocks and watches they already owned and purchase brand-new devices. Instead, horologists would have to find a way of converting France’s existing timekeepers to display decimal time. This was hardly a trivial matter. It was estimated by one clockmaker, Robert Robin (1741–1799), that there were 15 million watches at large in France at the time. They would all need to be converted – and quickly. It would be hard enough to modify simple, time-only mechanisms. Converting striking clocks and repeating watches to the new system would open a new level of complexity.

Some of the greatest names in French horology set their ingenious minds to this challenge, including the likes of Ferdinand Berthoud (1727–1807), Jean-Baptiste Lepaute (1727–1802), and Antide Janvier (1751–1835). World-class scientists such as Joseph-Louis Lagrange (1736–1831) and Jacques Charles (1746–1823) also lent their intellects to the problem. They all struggled to find a practical solution. Some inventors wondered whether the clock mechanisms themselves might be left alone, with only their dials modified. An anonymous manuscript in Paris’s Musée Carnavalet depicts just such a dial, designed for attachment to an ordinary two-handed clock. The dial comprises a multicolored series of chapter rings spiraling inward, with a complex set of numerals, notations, and symbols carefully inscribed in tiny lettering. Detailed instructions for how to read the time on this novel decimal dial occupy an entire accompanying page of closely written text (see page 40). The rules are so complex that they must have left even the most committed Republican longing for a return to the old days.

As the task of converting 15 million watches was being investigated, some makers, hoping to capture the more affluent market, focused on new manufacturing. A number of elegant and ingenious decimal clocks and watches were indeed constructed in the 1790s. Most, like the series of watches now held in the Patek Philippe Museum’s Antique Collection in Geneva, incorporated both decimal and conventional indications (see right, and pp. 36 and 41). Some watches, and clocks too, could have two separate dials, one for each system (see right, center). But these clever twin-mechanism timekeepers hardly felt like ringing endorsements of the



Pocket watch with decimal hours, 1794, Inv. No. S-906

Double-faced pocket watch, c. 1795, Inv. No. S-971

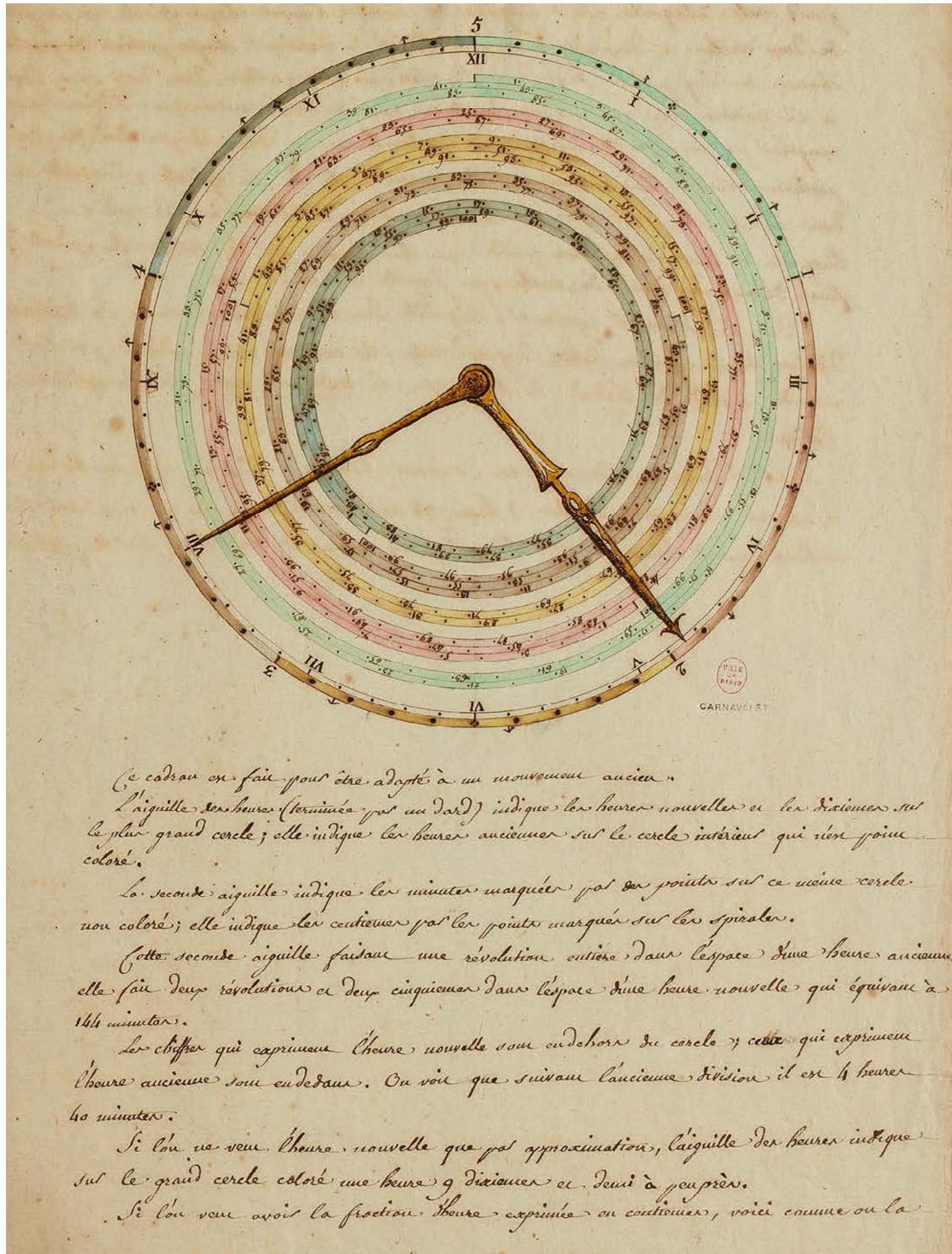
Pocket watch with decimal hours, c. 1795, Inv. No. S-955

Opposite: wall and ceiling reliefs inside the 2,000-year-old temple of Hathor, at Dendera, Qina, Egypt, show the Ancient Egyptians’ knowledge of the cosmos and 12-based calendar. One of Dendera’s ceiling reliefs (now in the Louvre, Paris), called *The Dendera Zodiac*, portrays a complete map of the Ancient Egyptian sky.

This page: these three key wound pocket watches offer different ways of showing two time systems. A yellow gold 52 mm pocket watch with a movement by T.H. Cuenin (top) has the hours and minutes of decimal time in black Arabic numerals and the duodecimal hours innermost, on two sets of 12 Roman numerals. The

red duodecimal minutes are on the dial’s periphery. Another pocket watch – 51 mm, yellow gold, and likely made in Geneva – has one dial (center, left) to show duodecimal time and a reverse dial for decimal time (center, right). It also has two calendars, one for the days of the month up to 31 on a sub-dial at nine

o’clock and one for the Republican calendar month up to 30 at three o’clock. Lastly, a 55 mm Geneva-made silver pocket watch (bottom) has red Arabic numerals in two sets of 12 for duodecimal hours and black Roman numerals for decimal hours, with the Phrygian cap and banners of the French Revolution



Pocket watch with decimal hours, c. 1795, Inv. No. S-792



Pocket watch with decimal hours and calendar, c. 1800, Inv. No. S-935

This page: a silver-cased 53 mm key winding pocket watch made in France (far left) displays duodecimal and decimal time as well as the decimal calendar, all indicated by the center hands. A 60 mm silver pocket watch from around 1800 with a key winding movement by Droz (left) has an innovative display of both time systems, giving the duodecimal hours (12), decimal hours (five), and minutes (60) on a sub-dial in the lower half of the dial, with the days of the month

(31) on the top-left sub-dial and the Republican calendar days of the month (30) in another sub-dial, top right. Opposite: this anonymous drawing shows, as the notes explain, a dial for indicating the "hours and minutes following the old division [duodecimal], and the hours, tenths, and hundredths following the new division [decimal]." The time that is indicated is "following the old division, four hours and 40 minutes; and, following the new division, one hour 94-and-a-half hundredths"

AFTER LITTLE MORE THAN A YEAR, THE GREAT REVOLUTIONARY EXPERIMENT TO RATIONALIZE OUR TIME OF DAY HAD ENDED

revolutionary decree. They looked more like the hedging of bets, covering all odds.

The fact was, hardly anybody in France wanted decimal time. Most people owned a clock or watch simply to find the time of day, whether they read it from a dial or heard it from the chiming of a bell. They did not use timepieces to make mathematical calculations. Such lofty practices were the preserve of astronomers and physicists. And these specialists hardly constituted a mass market.

Whatever the politics of decimal time, it was economics that caused its apparent downfall. Even if the people of France had all been enthusiastic, even if the technical challenges could have been overcome, and even if 15 million watches could somehow have been converted to the new system, there would be no market for decimal timekeepers outside France. Within months, the Republican authorities had realized the scheme was doomed. In 1795, the decimal time decree was suspended, indefinitely. After little more than a year, the great revolutionary experiment to rationalize our very time of day had ended in failure.

Or had it? The idea itself had not died. Lobbying for the decimalization of time continued fitfully for more than a century after its abandonment by the French authorities. For some proponents, only the purest decimal system would do. These idealists, like the French revolutionaries, would be eternally disappointed. Others, with more pragmatism, realized that it was the smaller intervals of time – at the level of minutes and seconds – that really mattered to the astronomers, scientists, and other mathematical specialists who had long pushed for change.

As the nineteenth century gave way to the twentieth, new uses for precision time were flourishing, requiring subsecond accuracy: the likes of ballistics research, psychological experimentation, electrical engineering, telecommunications, and sport. The timepieces built to serve these industries increasingly had to provide decimal readouts of tenths, hundredths, and thousandths of a second.

In the real world, change is often slow and quiet. It lacks the heat and clamor of revolutionary fervor, but it can be inexorable. In civil life today, we might have retained

the duodecimal and sexagesimal time of the ancients. The clocks in our homes and the watches on our wrists still show us the system of hours, minutes, and seconds that was first described thousands of years ago. But the tiny time intervals used by financial traders, IT professionals, sports people, and scientists the world over are now expressed in the notation of milliseconds, microseconds, and nanoseconds. The modern world runs on decimal time, even though these clocks are hidden from view.

The time historian Anthony Turner wrote, "Slow empiricism eventually found a compromise solution for the decimalization of time that rationalist thinkers and government commissions had failed to achieve." There was no need for a revolution at all, just practical necessity. ♦

This article draws on the scholarship of Anthony Turner, from his chapter "Decimal Time," in A General History of Horology, ed. Turner, Nye, and Betts, Oxford University Press (2022)

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