The watch that tells the time around the globe

Among the ancestors, the Rouzier & Melly watch of around 1780 (left) gave the local times of 53 towns. The 1885 "sphéromètre" (centre) signed by J. L. & A. Béguelin in Tramelan, Switzerland, shows 25 towns in front and 43 on the back. On the right, the Achille Hirsch watch of around 1900 displayed the 6 major local times surrounding Paris on the front and no fewer than 140 others on the back.

Jean-Philippe Arm

Whether they're called World Time or Universal Time watches, the kind that permanently shows the time in all 24 timezones designated by as many or more localities can boast a most useful complication and a distinguished horological pedigree. They take you back in history, to the age of exploration, long journeys and the quest for a seaworthy timepiece, accurate enough to give you longitude. They tell how nations agreed on a common reference from which to slice the global orange into 24 mostly equal and geopolitically acceptable segments.

The most eloquent models are based on a mechanism dating from the 1930s, and any new versions are bound to attract attention – like the World Time model presented in Geneva at the SIHH luxury-watch salon in January by a local brand, Vacheron Constantin. There was no lack of competition in this winter market spread between the official salon and an increasing density of fringe stalls. It's not easy to stand out among the amazing gadgetry, artwork and craftsmanship, let alone the crazy ideas and original concepts that struggle for centre stage. Then you have to face Baselworld two months later, when the pressure is even greater.

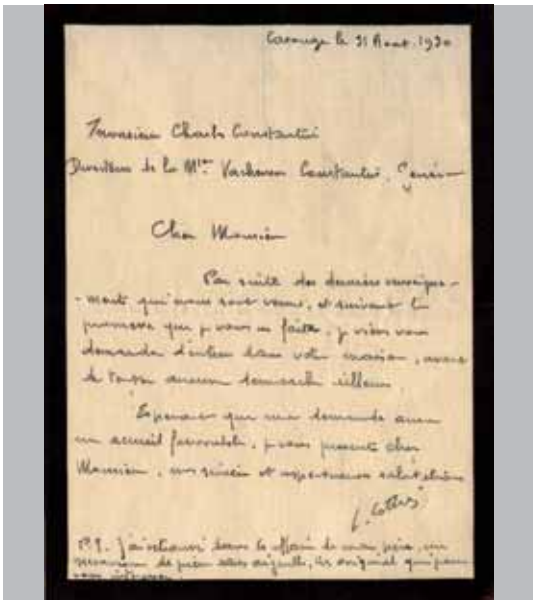
The status enjoyed by this geographic time indication is remarkable considering that it is not classified among the great complications, although it is regarded as a somewhat rare classic. This relative modesty did not however stop an old World Time model signed by the Geneva company, Patek Philippe, (ref. 1415 in platinum) from breaking the price record for wristwatches at an auction in 2002: 6.6 million Swiss francs. Another model in gold with an enamel dial from the same year, 1939, was sold for a bid of 2.7 million. Such cash values, which are due to a number of factors, magnify the fascination of the World Time watch. Besides, it has the right cultural and scientific associations to confer the utmost respectability.

The international agreement that fixed the Greenwich meridian as the prime meridian followed the Washington conference of 1884. It brought together

representatives of around 25 countries, but it took several decades before Greenwich Mean Time was widely adopted as the time standard. Even today there are local times that insist on differing from GMT by a half or a quarter of an hour. Switzerland aligned its Bern mean time with central European time, 15° East of Greenwich or GMT+1.

Gallic pique. Such honour given to the Royal Observatory in Greenwich went down badly with the French whose Paris Observatory was three years older. France stood by the Paris Meridian. Britain suggested it might adopt the metric system – one of the glories of the French Revolution – if the French succumbed to Greenwich. France gave up its nine minutes of difference, joining its European neighbours in 1911, when it accepted the Greenwich prime meridian. Britain never kept its side of the undertaking.
That historical footnote reveals the symbolic importance and national susceptibilities involved in such issues. It should be remembered, however, that the United States refrained from imposing an American meridian, although it was keen to have a time standard for its growing railways. The main advantage of the European 0 meridian is that it would put the 180° meridian for the date change at midnight through the middle of the Pacific. Nevertheless, adopting GMT meant following the British habit of starting the day at noon. Thus the morning ended one day at 0 hours GMT and the afternoon started the next. It took almost a century to correct this cultural aberration with the introduction of UTC – Coordinated Universal Time – in 1972. Today's time reference is based on the mean frequencies of 200 atomic clocks, and it starts the day at midnight.

Master Cottier. It also took time, though not as long, before the watch industry took an interest in time beyond a local zone. In the early 1930s an independent watchmaker in Carouge, near Geneva, devised a clever mechanism that gave the time in all timezones on a single dial at a glance. Louis Cottier thus became the pivotal figure in any research into this watchmaking speciality. His work unavoidably leads to the Vacheron Constantin



© Vacheron Constantin, Patek Philippe

From the archives: Louis Cottier's job application to Charles Vacheron dated August 31, 1930.

World Time model, the latest reincarnation of the Cottier system.
The idea of showing different local times is not new. Those big 19th-century pocket-watches with an arrangement of subdials for the times in major capitals are quite common in auction and exhibition catalogues. An exhibition of the Beyer collection at the last SIHH luxury-watch salon in Geneva featured a timepiece made in 1780 with the names of 53 towns around a 24-hour disc rotating anticlockwise. This is certainly an ancestor of the Cottier solution, made by Rouzier and Melly, two Geneva watchmakers. A couple of steps away was another cousin in the World Time genealogy among the 270 pieces of the Cartier exhibition. It showed the time in around 50 localities. One must remember that before 1884 there were hundreds of local times.
The decisive emergence of the World Time watch in the 1930s is attributed to the growing importance of air travel and telecommunications. Louis Cottier's invention came at just the right time. Produced with the jeweller, Baszanger, in 1931, it immediately attracted the big names in Geneva watches who commissioned pieces or entered into profitable and personal partnerships with this creative watchmaker. One shouldn't forget that this kind of cooperation has been more the rule than the exception in the watch industry. On this occasion, the main beneficiaries were Patek Philippe, Vacheron Constantin and Agassiz (Longines). Nor did Louis Cottier complain about his lot, although he did not deliberately choose it. Hans Wilsdorf, the founder of Rolex appointed him to look after his collection.
The researcher's reward is to come across some gem in the archives that throws light on the watchmaker's situation. It's a job application to Vacheron Constantin by Louis Cottier shortly after the death of his father Emmanuel in 1930. Emmanuel, who was born in 1858, had worked with the Geneva firm in his youth, before opening his own workshops in Carouge. Vacheron Constantin was a regular client. His son, Louis, had done brilliantly at watchmaking school and was working at his side. But when Louis inherited the workshop in the wake of the 1929 crash, things looked bleak for the family business.

Three historical models dating from 1932, 1936 and 1946, including on the left the first Cottier Universal Time watch signed Vacheron Constantin.

Selfwinding Vacheron Constantin model of 1957 with a button at 9 o'clock to turn the disc of towns.

The letter to Charles Vacheron dated August 31, 1930 suggests a privileged relationship: "… I'm asking to join your firm before making any enquiries elsewhere." He adds as a postscript: "I found among my father's things a most original movement for a watch without hands that might interest you." But the times were tough for everybody and the brand, which was struggling to keep its own jobs, could not hire him. The past cannot be undone, but it is tempting to speculate on a different outcome considering the contribution made by Louis Cottier as a free electron.

Couldn't be simpler. The first Cottier World Time watch signed by Vacheron Constantin (ref. 3372), appeared in 1932. It's a pocket-watch with the times of 31 cities on the dial. The basic principle is clever. At the centre there's a dial with hands showing the hours and minutes of a selected local time. Around it, a 24-hour ring turns anti-clockwise one step every hour. Surrounding that is a fixed disc displaying the reference cities with the home city conventionally at 12 o'clock. For example, the watch shows 10 past 10 and you are in Geneva, which is opposite the 10 on the 24-hour disc. Next to Geneva, London is opposite the 9. An hour later, the hands show 11 o'clock, the ring has moved a step and shows that it is just after 10:00 in London, 07:00 in Rio and 20:00 in Sydney, and so on 24/24. Universal time is as simple as that.

A World Time watch shouldn't be confused with the countless watches dubbed "GMT" with their variations on the timezone theme. (It would be more correct to follow the French watchmaker, François-Paul Journe, in adopting the term UTC for timezone watches.) Timezone watches make it easy to change to the time in another zone or to display two or even three local times (see *Watch Around* N° 5), but there is no permanent and automatic display of the time in all 24 zones. The confusion comes from the presence of towns associated with the choice of a second timezone.

The Cottier solution has evolved over the years with improvements and additions but the basic principle has remained the one laid down by its inventor. Vacheron Constantin brought out two more models, both pocket-watches, four years

These two Patek Philippe World Time models are nearly 70 years apart. The first, produced in 1939, broke all records when it sold for CHF 6.6 million at auction in 2002. The second, with a cloisonné enamel dial, was made in 2008.

later in 1936. One had the same 31 cities and the other, only 30, Cairo having mysteriously vanished. In this regard, one touches on one of the interesting aspects of World Time dials, which reflect the geopolitical context of the times, tracking the relative importance of the selected locations as markets or islands. It's not surprising that the island of St Helena used to be mentioned.

Stops on the trans-Siberian. The piece in the collection of the MIH international watchmaking museum in La Chaux-de-Fonds, which was on display in Geneva in January, has to be the archetypal travel watch. It shows the time in 140 locations including the major stops of the trans-Siberian railway. It's a boon for researchers, considering that the route changed for political reasons along the Russian-Chinese border. The dial has become a snapshot of an era, a document of record. According to Dominique Fléchon, historian for the *Fondation de la Haute Horlogerie,* and about to retire: "Watches that explore the indications that can be derived from a familiar mechanism take you beyond watchmaking into a different dimension, and that is exciting."

The World Time watches also give clues about the original owner from the locations that are selected – where he has friends, does business or goes on holiday. Unlikely locations always crop up. South Georgia in the south Atlantic for example, whose only timezone rival is Greenland, would be unknown to all but the British, if it weren't a regular on the World Time dials representing the timezone between the Azores and Rio. Since the local time is a political or administrative decision that might not conform to the right timezone, the Azores sometimes take the place of South Georgia.

In the late 1930s, Vacheron Constantin used the Cottier system in a series of table clocks that featured 67 locations. World Time watches have since appeared regularly in the collections over the ensuing decades. In the 1940s the International Time model included 41 cities and adopted the day

and night indication. At the end of the following decade, a selfwinding wrist model came out with a pushpiece at 9 o'clock to move the mobile cities dial. It reappeared in a hunting-cased pocket-watch of the 1960s, subsequently in the Phidias collection and lately in limited-series watches in the 2000s.

Patek's turn. At the same time, Louis Cottier developed his mechanism with the other Geneva watchmaker, Patek Philippe, who filed a patent in 1959. In its wake came a device for the simultaneous display of two local times, which reappeared in the Travel Time wristwatch of the late 1990s. Louis Cottier had died in 1966, but not before leaving a prototype of a watch without hands and dial. Patek Philippe declined to produce it, but it inspired the Geneva-based Urwerk company to introduce its Cobra watch last year (see *Watch Around* N° 9).
Patek Philippe brought Universal Time back into its collection in the 2000s on its slim calibre 240 self-winding movement with an offset mini-rotor. The 24-hour mechanism is isolated from the going-train of the watch so that the local time can be changed at any time without affecting its rate. In 2008, the company made the inner dial of its World Time watch in cloisonné enamels.
It's a great tribute to Cottier that his watch that showed the time around the world should be back on centre stage in 2011, some 80 years since its debut. The model, fittingly signed by Vacheron Constantin in its Patrimony collection, features a new development that Louis Cottier would have approved of.

Timezones out of phase. The Vacheron Constantin model accounts for the renegade timezones such as the Indian half-hour or the Nepalese quarter-hour. Among its 37 reference localities are a good dozen cities, states or islands where the official local time varies from its timezone by 15 or 30 minutes. You have to set the minutes hand as well as the hours for Delhi, Teheran, Kabul, Adelaide, Caracas, Kingston, the Marquesas Islands and Nepal. A few timezone watches, for example, the Tonda Hémisphères by Parmigiani, cater for such irregularities, but to do so on a World Time scale is an achievement of a higher order.
The display uses three dials. One is in metal and shows a conical projection of the world with the North Pole in the centre; the second, in sapphire-crystal, darkens from day into night over 24 hours; the outer chapter ring, in metal, is marked in minutes. The home city, the local time of which is shown by the hands, is positioned opposite a small triangle at 6 o'clock on the chapter ring. All the functions can be set by the crown. The 28,800 v/h (4 Hz) selfwinding movement inside the 42.5 mm pink-gold case with sapphire-crystal caseback has a power reserve of 40 hours. A patent application has been filed.
Before concluding this special report with an investigation into Harrison and the unwinnable Longitude Prize, we should like to recommend a visit to our site, www.watch-around.com, where you will discover the timezone watches (wrongly yet persistently known as GMT or UTC watches) that are the poor relations of the venerable World Timers. ●

The Patrimony Traditionnelle Heures du Monde presented by Vacheron Constantin in January 2011 at the SIHH.

Should Harrison have won the Longitude Prize?

The Scilly naval disaster in which more than 1,400 sailors died in 1707 prompted the British parliament to offer a huge prize for a way to find longitude.

Ilan Vardi

Watch aficionados appreciate John Harrison's solution to the longitude problem as it marks the consecration of the watch as a legitimate scientific instrument. But Harrison faced much resistance and his conflict with the Board of Longitude charged with evaluating his work turned an interesting discovery into a compelling tale of a lone genius flouting the scientific establishment. The Board's scientific objections will be the subject of this article, but first a recap of the longitude problem.

Since the age of discovery, difficulty in determining longitude at sea made for treacherous navigation and by 1714 losses due to longitude errors convinced the British Parliament to offer a Longitude Prize of £20,000 for a successful solution, a sum equivalent to millions today.

The condition was to sail from England to the Caribbean, a six-week voyage, and determine longitude upon arrival to within half a degree. Since longitude is equivalent to the difference between local time and Greenwich Mean Time, the most direct solution is to bring a watch set to GMT and compare it to local time, the half-a-degree condition being equivalent to having at most a two-minute error at the destination. Though simple in theory, this turns out to be extremely difficult in practice and even today's mechanical wrist-chronometers are not rated for this level of accuracy.

And there was competition from the lunar distance method, the most satisfying solution to scientists as it conformed with the contemporary Newtonian view that the motions of heavenly bodies could be completely understood by simple physical laws.

On the other hand, watches were made by artisans and Harrison was confronted with scholars who dismissed him as a "mechanic." The Board became progressively disenchanted with Harrison to the point where their continually evolving demands became direct harassment. Nevertheless, John Harrison's H4 chronometer underwent two sea trials in 1761 and 1764, which it passed brilliantly, and yet Harrison was still not awarded the prize. It is time to explain why.

John Harrison (1693-1776). A revised version of Harrison's portrait published in 1768 adds his greatest invention to the picture – the first proven longitude chronometer, H4, appears on the table.

Harrison's claim that his H4 watch lost only five seconds (corrected for rate) after a 61-day sea voyage seemed too good to be true for the Board of Longitude. Such accuracy would be beyond even today's mechanical chronometers.

Flawed conditions. The main reason is that the conditions for winning the prize were set without a full understanding of the issue. Indeed, a sea trial requires a very precise knowledge of the destination longitude, which was not possible at the time. The second sea trial of 1764 bears this out: astronomers computed the time difference between Portsmouth and Barbados to be 3 hours, 54 minutes and 18.2 seconds, while Harrison's watch gave 3:54:56.6 a difference of 38.4 seconds, well within the two-minute requirement. However, a recalculation using Google Earth shows that the time difference cannot be more than 3:54:10, so the test benchmark of 1764 was itself off by about 10 seconds. This imprecise knowledge of the longitude of Barbados gives Harrison's result a 10-second degree of uncertainty still comfortably inside the two minutes.

However the same degree of uncertainty, when applied to Harrison's claim that H4 lost only 5.1 seconds on its first voyage to Jamaica in 1761, makes this oft-quoted result meaningless. In this case the result is simply under the precision level of the test, so the error of the H4 watch cannot be declared more explicitly.

Surprised by this result from the first trial, the Board of Longitude correctly conceded that Jamaica's longitude was not known precisely enough to validate it, and much more care was taken on the second trial whose result was accepted.

But any trial at sea is completely insufficient: just knowing that a watch was accurate at the beginning and end of the journey is of little practical use since it reveals nothing about its accuracy during the voyage when reliable longitude is absolutely required. In other words, the watch could have been many minutes off during the voyage and, by some fluke, returned to almost correct time only at the end.

Nothing to compare with. So daily testing is required. However it is evidently impossible to measure a chronometer's ability to find a longitude out of sight of land without knowing the true longitude at the time.

The Board was fully aware of these limitations, and remained dissatisfied with the H4 sea trials, however

Harrison's sea-clocks were the first to be rated at an observatory.

successful they appear to have been. It eventually realised that the most sensible test required daily measurement at an astronomical observatory where the transits of fixed stars gave the only time standard against which to evaluate a watch and the longitude was always the same! This explains why the Board of Longitude confiscated H4 and had it tested at the Greenwich Observatory, despite the fact that the watch had already met the conditions of the Longitude Prize. The Board's good judgment has been confirmed by the subsequent centuries of chronometer testing carried out almost exclusively at observatories.

The misunderstood rate. Analysis of the Greenwich test data was a further scientific challenge, since watch error does not generally have a normal statistical distribution and is similar to a random walk. This problem proved insurmountable for Astronomer Royal, Nevil Maskelyne, in charge of assessing Harrison's watch. He thus declared it unsuitable, partly because he was unable to extrapolate an average error – the rate of the watch. The rate is the average amount a watch loses or gains a day. A watchmaker cannot hope to eliminate that daily loss or gain, but will adjust his instrument to achieve a constant and predictable error. A known rate of say two seconds slow a day provides a correction factor to bring the time shown on the watch closer to true time. For example, after a 10-day voyage, you add 20 seconds to get the correct time. In the 1761 trial, the H4 accumulated an error of minus 168 seconds after a 61-day voyage, but Harrison had declared a rate of 2 2/3 seconds slow a day. Over 61 days that amounted to almost 163 seconds, reducing the error to minus 5 seconds.

This manipulation was not well received: Harrison had not formally announced the rate, so the Board could suspect that it had been chosen after the fact. Furthermore, the concept of rate was not understood by some of the Board's commissioners.

The first trial was therefore invalidated. For the second trial, Harrison made sure to send a sealed letter to the Admiralty announcing a rate of one second fast a day, and by 1765, the notion of rate was sufficiently clear to the Board, which accepted the corrected error for the second voyage.

Conclusion. It appears that the demands of the Board of Longitude were justified in view of the Longitude Prize's naive formulation and the Board's unfamiliarity with chronometry. The fact that Harrison prevailed is a testament to his genius and perseverance, but also to the Board's scientific magnanimity.

An acceptable test method was only devised 60 years after the Harrison trials by Maskelyne's successor as Astronomer Royal, George Biddle Airy, one of the rare scientists to have done significant work in horology. Harrison's test results were finally accepted after spirited intervention by King George III, who took a personal interest in these trials.

Once one becomes aware of its inherent faults, it is not surprising that no one ever won the full Longitude Prize, though in the end, John Harrison received a total of £23,065 in awards and grants, amounting to more than the prize money itself. ●