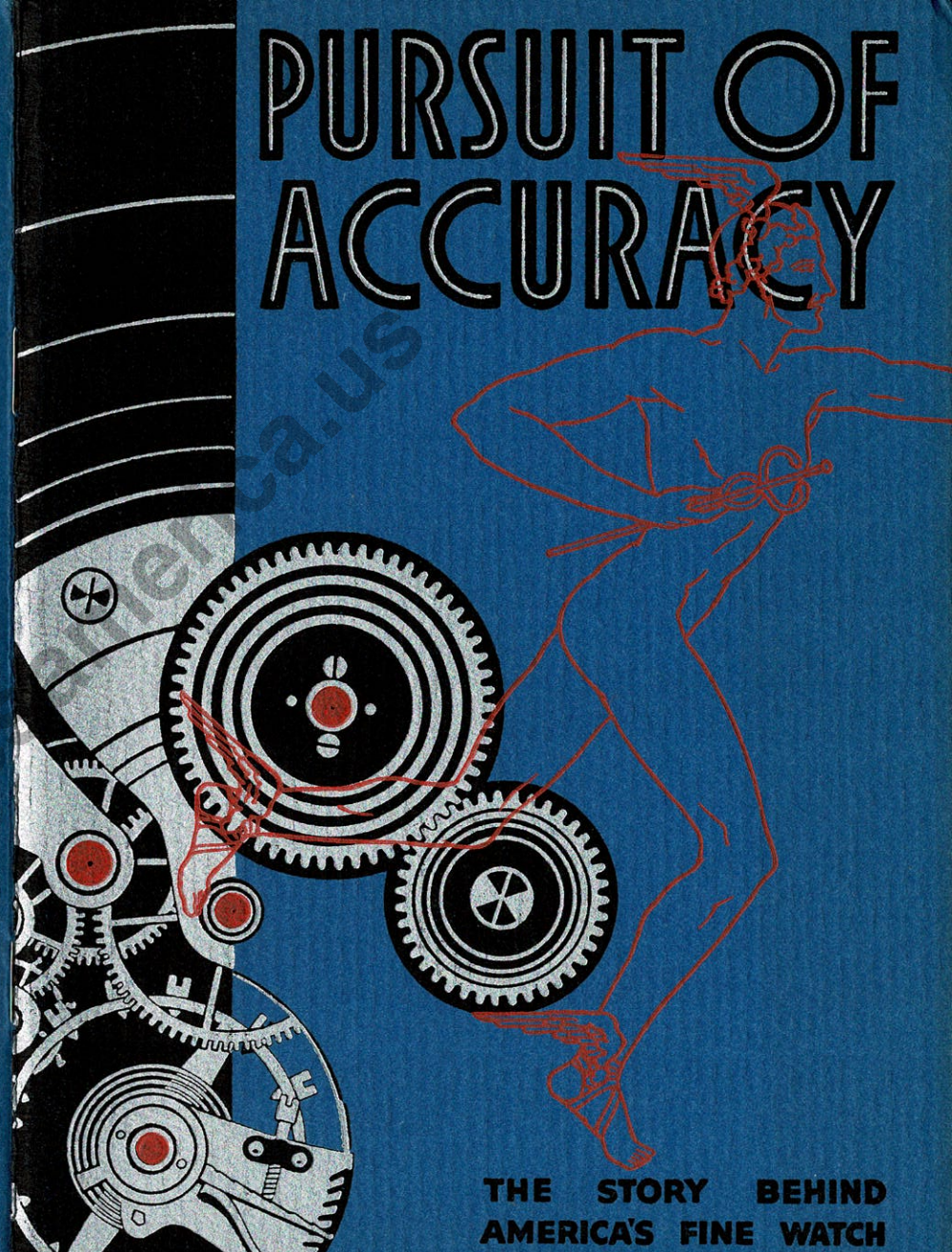
PURSUIT OF ACCURACY



THE STORY BEHIND AMERICA'S FINE WATCH

IF—

"If you can fill the unforgiving minute
With sixty seconds' worth of distance run,
Your's is the Earth and everything that's in it.
And—which is more—you'll be a Man, my son!"

Rudyard Kipling.

PURSUIT OF ACCURACY

THE STORY BEHIND AMERICA'S FINE WATCH

HAMILTON WATCH CO.
LANCASTER, PA.

FOREWORD

HAVE you ever, at the end of an eventful journey, looked back along the path you traveled? If you have, you will delight in looking back with us over the trail of mankind's tireless pursuit of accuracy in timekeeping.

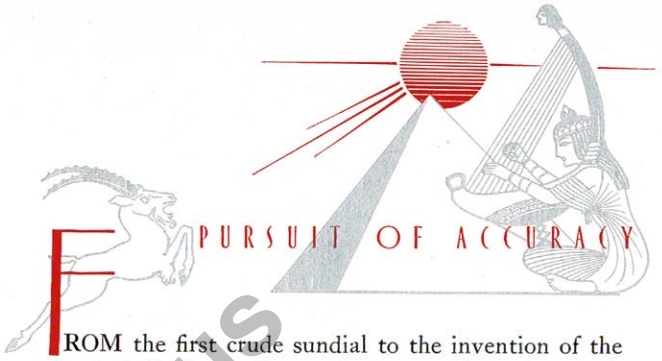
The ability to measure time and subsequently to control its flow with increasing accuracy is, perhaps, man's greatest accomplishment. And every stage in this progress from the first crude sundial to the modern American watch is marked with milestones which stand as lasting memorials to his achievement.

This booklet presents a short review of mankind's persistent effort to devise more and more accurate means for measuring time. The latter part of this story is devoted to a detailed description

*The Nocturnal; a 17th Century navigation instrument similar to the Astrolabe but used for determining time at night.

of his present efforts—the manufacturing of fine watches.

So let us quickly survey the history of timekeeping, and then peer by proxy over the shoulders of the skilled craftsmen who manufacture, inspect, and assemble the tiny parts of Hamilton watches. Thus may we sharpen our appreciation for that tiny mechanism which day after day, year after year, serves us as an accurate and faithful timekeeper.



PURSUIT OF ACCURACY

FROM the first crude sundial to the invention of the mechanical clock, the interesting story of man's travels through the pages of timekeeping history divides itself into three major chapters *according to the source of power or activating medium.* They are the *rays of the sun, fire,* and *water.* These do not fit readily into a chronological sequence because in their early stages they involved basic ideas which occurred to various peoples in widely separated areas. Eventually the three stories converge at that momentous point in civilization's history when mankind achieved the weight-driven clock, and its successor the spring-driven portable timepiece or watch. So in the first few pages of our story we will disregard the true chronological order and describe each of the three power forms briefly from beginning to final stage. We can profitably add a note on the important matter of star observation and calendar systems before we launch into the more detailed description of the mechanical predecessors of the watch as we know it today.

THE SUN

Man's first timepiece was the earth itself revolving on its axis as it swung about the sun. Thus the primitive year was divided into seasons, and the day into light and

darkness. Out of these simple alternations must have come man's first consciousness of recurring time cycles.

The hours of light were the hours of greatest activity—whence arose the first problem of time division, and its first simple but adequate answer. A pointed rock and a circle of stones were in all probability the result of prehistoric man's first effort to *make* a timepiece.

Later civilization observed more closely the movement of shadows as the sun swung across the sky, and used their growing knowledge in the construction of improved sundials. First recorded mention of this type of timepiece occurs in a Chinese manuscript dated 1100 B.C. The Bible refers to Isaiah's famed dial of Ahaz (B.C. 800) which cast its shadow on a circle of steps.

The early man-made sundials utilized a single vertical rod or "gnomon" set on a flat dial. But soon mankind discovered that a sundial of this type varied considerably with the seasons, due to the changing length of days. So other types were developed. An early Egyptian dial (now in the British Museum) was constructed to face the East in the morning, and was changed by hand at noon to face the West. All of these dials considered only the length of the shadow; it remained for the Greeks to utilize the swing of the shadow by developing a gnomon made in the form of a triangle whose hypotenuse pointed directly to the North Star.

Since the operation of this type of timepiece depended upon the position of the sun, the changing seasons created a major problem which was only partially solved by the invention of the hemicyclium, or half-sphere, with the shadow cast on hour lines converging at each end of the diameter.

Sundials were widely used in both Europe and America because they were relatively inexpensive and required little care. However, they served only when the sun shone and man sought further for a timepiece to divide the hours of gloom and of darkness.

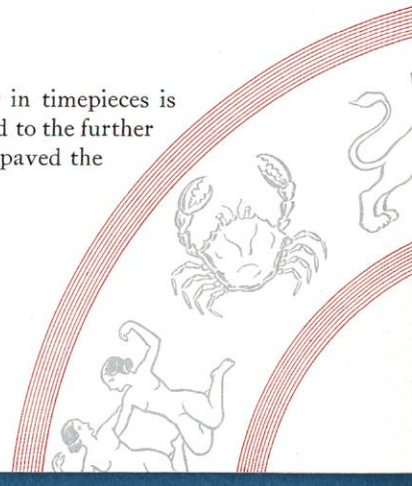
FIRE

Primitive man ingeniously solved this problem by devising a knotted grass rope which slowly burned and consumed the "hours" between the knots. China used joss sticks and in other parts of the East slow burning candle-nuts strung together, dropped off as time moved on.

The Pious King Alfred, seeking to divide his day into equal parts for work, for prayer, and rest, used a series of calibrated candles encased in a "lantern made of horn." Also common in Europe was the Lamp Clock which both provided light and told time by the level of the oil remaining in its reservoir.

WATER

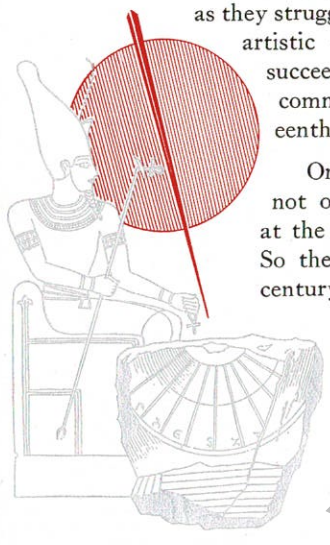
The use of water as motive power in timepieces is most important because it eventually led to the further development of time-mechanisms, and paved the



way for true mechanical timepieces. The first water clocks were, of course, extremely simple. Three thousand years ago, Hwangti (Yellow Emperor) of China, had a timepiece which consisted of a pierced brass bowl floating in a large basin of water. At the moment the bowl filled and sank, it was retrieved by a slave attendant who struck the hour on a huge gong to mark the time for all within hearing distance of the royal palace. On early Chinese junks, sailors utilized the same principle by substituting pierced cocoanut shells for the brass bowls.

Greeks devised the Clepsydra ("thief of water") in which slowly escaping water raised or lowered a float which pointed the hour. Clepsydras were used extensively as community clocks and to time speech-making in the Roman Senate.

Early civilized man's native ingenuity found ample opportunity for exercise in the refinement and elaboration of the Clepsydra. Intricate mechanisms were developed as they struggled to improve the timekeeping qualities and artistic design of their clocks. So well did they succeed that adaptations of the Clepsydra were common throughout Europe as late as the eighteenth century.



One weakness, however, the Clepsydra could not overcome: the tendency of water to freeze at the extreme temperatures of northern latitudes. So the Church entered the picture in the eighth century when Luitprand, a monk of Chartres, substituted sand for water, and invented the hour glass.

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The study of the stars is so closely allied with timekeeping that it cannot be omitted from even the briefest history of horology. Four thousand years ago early Babylonian scientists observed the stars and divided the year into twelve equal parts by marking twelve star groups or constellations through which the sun seemed to pass as the seasons changed. To these star groups they gave the names of animals, and so began the Zodiac which even today remains in common use. The Babylonians also celebrated the week by giving to each of their seven celestial Gods a day for himself. Thus we have a Sun Day, a Moon Day, and a Saturn Day.

On the other side of the world aboriginal Americans also studied the stars. Beginning over two thousand years ago the Incas, Aztecs and Mayas worked out a calendar system based on a 365-day year—with proper allowance for leap years. Their calendar was divided into 18 months of 20 days each—with five days left over for holidays.

Later civilizations in the Old World brought the Astrolabe, a mariner's instrument for determining position at sea—forerunner of the sextant and subsequent devices for taking time from the stars.

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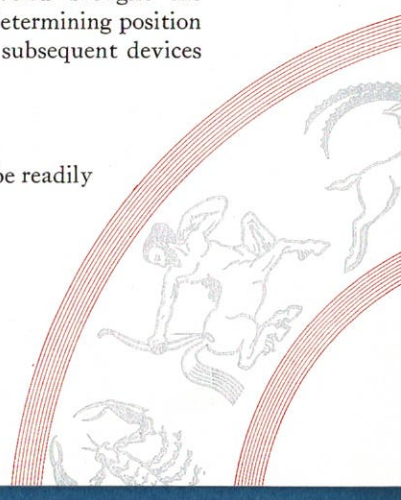
From the above brief sketch it can be readily



seen that the story of timekeeping has been a story of constant struggle toward ever increasing accuracy as the march of civilization has moved on. Each succeeding development reflected the trend away from devices which require close human supervision. The refloating of the brass bowl at exactly the right time; the sundial reversed at noon; the turning of the hour glass; the replacement of candles in King Alfred's time candle—these depended too much upon the human element. Mankind wanted and needed timepieces which operated with a minimum of human supervision—a factor which has been in a large way responsible for the converging of efforts in all quarters toward the development and improvement of the strictly mechanical clock.

No less a dignitary than Pope Sylvester II is credited with the invention of the first mechanical weight-driven clock in the year 996 A.D. The use of weights as motive power began a new and most important cycle in the history of time division. These clocks had no pendulums; were unreliable timekeepers. There is legendary report of a clock of this kind being placed in the now destroyed tower of Westminster Abbey about 1288. The first definite record of a true clock is that of one built in 1336 for the Abbot of Glastonbury by one Peter Lightfoot.

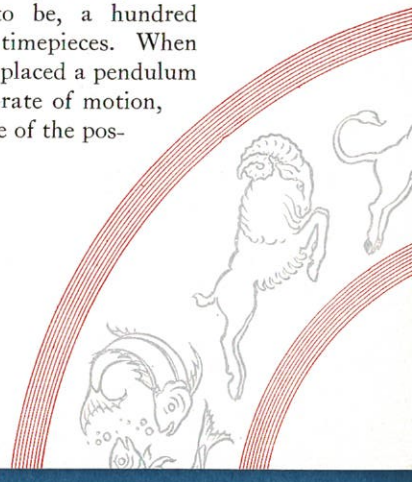
During the next hundred and fifty years weight-driven town and church clocks equipped with fantastic chiming and striking devices appeared all over Europe.

The actual beginning of the modern watch as we know it today may be traced to the creative genius of a young Nuremburg locksmith named Peter Henlein. In 1480 Henlein achieved a portable clock by substituting as motive power a coiled spring for the customary weights.

His first clock ushered in a series of "Nuremburg Eggs" —so named because of their shape. These soon became the common timepieces of the elite. Made entirely of iron they were so heavy that their owners employed page boys to carry them about during their fashionable promenades. Clocks of this kind were also used by the town watchmen, a circumstance which eventually caused them to be known as "watches."

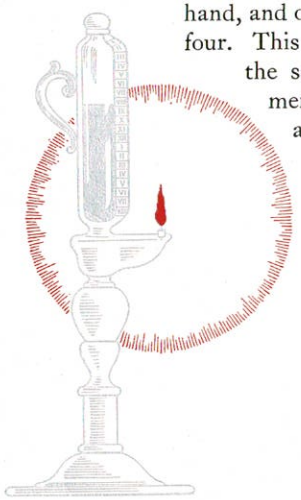
Thus far these early horologists had succeeded in constructing the mechanism of a timepiece, but they had not succeeded in incorporating any device which assured the even flow of power.

It remained for Gallileo in 1564 to discover from his observations of the great hanging lamp in the Cathedral of Pisa, that in the swing of a pendulum is embodied the secret of the invariable time constant. Important as we today know this principle to be, a hundred years passed before it was applied to timepieces. When Christian Huygen, a Dutch horologist, placed a pendulum in a weight driven clock to control its rate of motion, the world had its first prophetic glimpse of the possibilities of accurate timekeeping.



The pendulum principle could not be directly applied to the portable timepiece, but other important improvements were made. Brass replaced iron so that watches could be made lighter and smaller. The idea of constant and controlled movement in time recording had by now become a fixed idea in the minds of watchmakers everywhere. To overcome the annoying habit of a gradual "slowing down" as the spring unwound, a device known as the *fusee* was invented. It consisted simply of a piece of catgut or fine chain, wound on a spiral track of constantly increasing diameter. This had the desired effect of keeping a fairly even tension on the movement as the mainspring unwound.

Watches of this period became lavishly ornamental as watchmakers strove to make up for their lack of precision. Smart women changed their watch cases to match their costumes. It is recorded that in 1571 Queen Elizabeth of England was presented with a "wristlet in which was a clocke"—the world's first wrist watch. It had no minute hand, and often varied as much as one hour out of twenty-four. This watch and others worn by the fashionable of the same period were considered largely as ornaments—most people carrying a small sundial for actual time telling.

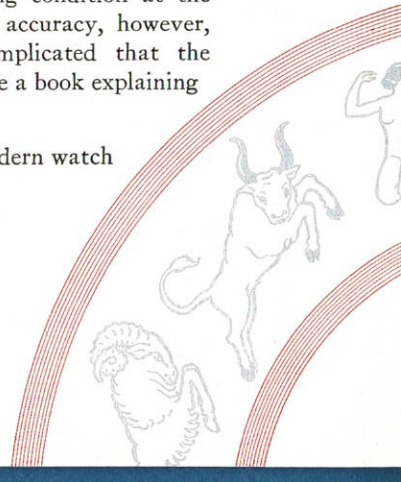


Dr. Robert Hooke of England made the next important contribution to portable timepieces. He conceived the idea of placing a balance spring in a watch to control its rate. The first "hairspring" used in 1685 was an actual hair—a hog bristle. Later Thomas Tompion, another English horologist, replaced the bristle with a metal spring, and his successor, George Graham, contributed the compensated balance wheel which completed the original "heart of a watch" as we know it today.

In the early years of the eighteenth century the British Government maintained a standing offer of twenty thousand pounds for any means of determining a ship's position at sea within thirty nautical miles after a six weeks' voyage. Reduced to practical terms, this meant the construction of a clock which should vary not more than three seconds in a day; a performance better than could be had even from the best pendulum clock then in use. The prize was not claimed for forty-seven years.

The unique distinction of meeting these severe specifications and so of constructing the world's first really accurate timepiece, fell to a Yorkshire carpenter turned horologist, John Harrison. The coveted prize was awarded to him in 1714. At the end of the five months' voyage to Jamaica, Harrison's chronometer had lost only two minutes. The original timepiece with which he won the award is still carefully preserved in running condition at the Royal Greenwich Observatory. Its accuracy, however, depended upon mechanisms so complicated that the government required Harrison to write a book explaining its construction and operation.

The fundamental design of the modern watch

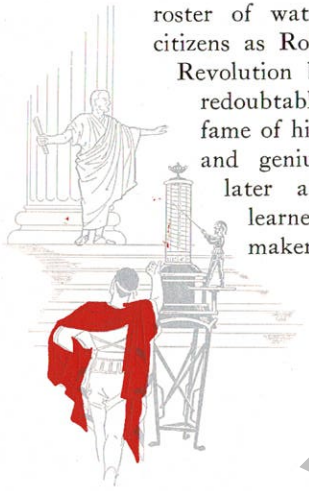


was developed as early as the eighteenth century, but many improvements have been made on almost every part of it; each contributing its bit toward greater accuracy and dependability It remained for modern America to perfect the *methods* of manufacture and to make possible economies of production which bring the price of modern watches within the reach of all.

WATCHMAKING IN AMERICA

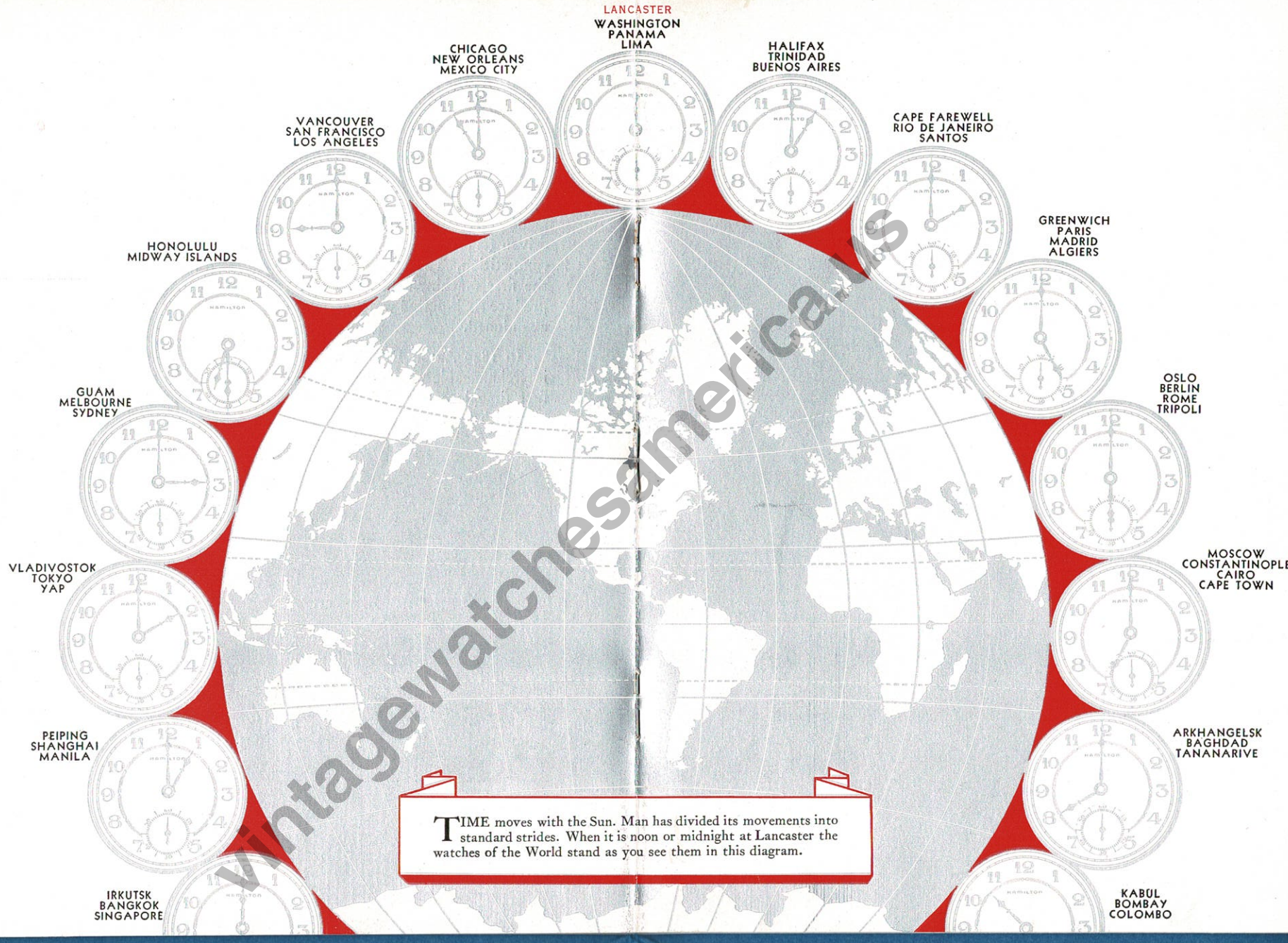
Yankee ingenuity could not resist the temptation to try its hand at watchmaking. The history of horology in America is a record of noble failures and of ever renewed progress built upon the ruins of those failures. To American methods and prowess, and to American persistence the American Watch industry owes its place of World leadership.

At the time of our American Revolution there were already many outstanding watchmakers at work in the American Colonies; not a few of them have left great names behind them as heroes and statesmen. Notable in the roster of watchmaker-patriots are such distinguished citizens as Robert Morris, who financed the American Revolution by pledging his personal credit, and the redoubtable Paul Revere, who does not need the fame of his midnight ride to qualify him as patriot and genius. Many other great Americans who later achieved distinction as inventors, first learned the meaning of precision at the watchmaker's bench. Among these Robert Fulton, Peter Cooper, Eli Whitney, Otto Mergenthaler and Henry Ford are particularly outstanding.



The first American watch factory was started in 1809 at Shrewsbury, Massachusetts, by Luther Goddard. He made five hundred watches by hand methods before being driven (eight years later) from the field by cheap foreign competition. The Pitkin Brothers of Hartford introduced the first machine-made watch in 1838, and managed to produce six hundred watches before the business had to be abandoned.

In 1849 Aaron Dennison conceived the basic idea of interchangeable watch parts and manufactured America's first timepiece of sufficient merit and cheapness to compete with the foreign product.



TIME moves with the Sun. Man has divided its movements into standard strides. When it is noon or midnight at Lancaster the watches of the World stand as you see them in this diagram.