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THE PROGRESS OF TIME-TELLING:

SUNDIAL TO PRECISION WATCHES

Telling time is one of the simplest human reflexes. A glance at one's wrist watch gives the hour, the minute, the second. Perhaps no other matter-of-fact determination is more fundamental to modern life.

To know the time with consistent accuracy is to be able to coordinate your activities with those of others, and with the events that constitute our world. The measurement of time makes possible the close ordering of space, things and events -- for human purposes.

A moment's reflection on the chaos that would result if, in our highly synchronized, technological age, time measurement were suddenly impossible, should suffice to underline the vital role of time-telling.

Man's efforts to create timing methods and instruments capable of increased accuracy are almost as old as civilization. The desire to approximate time existed in prehistoric man.

The cave-dweller searching the heavens and noting the rhythmic movement of the sun, its rising and setting, was indeed attempting a kind of time-telling.

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The beginning of "scientific" time-telling coincided with the emergence of farming and herding communities in the Middle East, and perhaps in China.

As early as 4000 B.C., Babylonian priests learned to measure time from the sun, the moon and the stars. Babylonian temples and palaces were built so that their towers cast shadows. The priests, who knew the secrets of the heavens, measured time from the shadows.

Shadow Clock Built in 1500 B.C.

About 1500 B.C., the Egyptians, who also had learned to approximate time by observing temple shadows, constructed a shadow clock. It consisted of two blocks of wood, "T" shaped and mounted on a wood base, which had lines to mark the hours.

The shadow clock was the precursor of the sun dial, which embodied the same principle of time-telling. Sun dials are still in use today, though their function is mostly decorative.

Various other simple but ingenious time measuring devices were in wide use prior to the inception of the true mechanical clock.

One of these - the hour-glass - may be seen in many modern kitchens. We call it an egg-timer. Sand, passing through from a higher to a lower level in a glass measures short periods of time but does not, of course, give the time of day.

Water clocks were used in some parts of the world. Water was put in a glass container having a small hole in the bottom. Hour marks on the container indicated time when the water level fell as the water dripped out. In ancient Rome, a water clock timed Senatorial orations.

Nearly 200 years before the discovery of America, mechanical clocks began to appear on church towers and town halls in Europe. These primitive mechanical clocks were not very accurate. A long rope with a heavy weight at one end was wound around a drum. As the weight dropped, it pulled the rope, which turned the drum. A brake regulated the drum's rate of turn. A hammer, attached to the drum, struck a bell on the half-hour.

The first crude mechanical clocks were inaccurate because a method of regulating the speed of the falling weight was unknown.

Swiss Put Pendulum to Work

Galileo, the Italian inventor and astronomer, solved the problem when, towards the end of the 16th century, he discovered the principle of the pendulum: the fact that every swing of a pendulum always takes exactly the same time no matter how far the pendulum travels; the length of the string from which it is hung will set the pendulum's time.

The first clock-maker to employ a pendulum to regulate the falling weights in a clock was a Swiss, Jost Burgi.

It proved a major breakthrough in the development of accurate timing instruments -- the first of many contributions made by Swiss technicians -- and by 1650 most good clocks used pendulums to control the speed of falling weights.

Although a clock that ran by weights regulated by a pendulum represented significant progress towards accuracy and dependability, it presented practical disadvantages. It functioned only in an upright position; cumbersome and heavy, it lacked portability.

Compactness and portability in a timepiece evolved, slowly, from the introduction and development of several new devices that permitted the elimination of weights and pendulum.

As early as 1500 A.D., Peter Henlein of Nuremberg, Germany, had contrived a comparatively crude coiled metal clock mainspring. Henlein's spring was used to replace falling weights as the power source in some clocks made during the 16th century, but they were generally not as successful or as dependable as the falling weights models.

But with the refinement of the Henlein spring and the use of another important innovation, the oscillating balance wheel to control the release or escape of the power, which made a pendulum unnecessary, something approaching portability in a timepiece was achieved.

'Watchman's Clocks' to 'Watches'

The first portable clocks were a far cry from the pocket watch of more recent times. However, it is from them that we derive the term 'watch'.

During the 16th and 17th centuries, these crude portable clocks, fitted into a box with a handle, were used by town watchmen on their rounds. Known first as 'watchman's clocks,' then 'watch clocks,' they were finally called, simply, 'watches'.

Inevitably, watches, powered by mainsprings and regulated by oscillating balance wheels, became more refined in construction and design -- and more widely owned. As overall size and thickness was reduced, they became true pocket watches. Cases became objects of the jeweler's and goldsmith's creative arts, and examples of these, many of which were once the proud possessions of princes and kings, are preserved in museum and private collections.

With refinement of construction and design came increased accuracy, and though accuracy to within an hour-a-day seems little enough compared to today's exacting precision standards, it was a considerable achievement in the late 17th century. Each part of a watch had to be handcrafted with relatively crude tools, and fitted together by hand.

The very early watchman's clocks and portable timepieces were apparently made by the skilled mechanics of the time -- blacksmiths.

The trade of watchmaking probably originated in southern Germany and northern Switzerland. It soon spread to France and England. In fact, during the last decades of the 17th century and the first quarter of the 18th, the latter countries were the centers of watchmaking.

But the center shifted once again to Switzerland, and it remained for the Swiss to develop watchmaking into the precision instrument industry that we know today.

Swiss Skill Dominates Industry

The reasons for the concentration of watch manufacturing in Switzerland and for Swiss domination of the industry are several.

When very early watches were being made, the most accomplished metal workers of the time were Swiss. It was fairly easy for these workers to adapt their skills to watchmaking.

Later, as watchmaking expanded into an industry, Switzerland was able to offer the highest level of mechanical, technical and engineering achievement. Moreover, her jewelry-makers were among the finest in the world, and she boasted a centuries-old tradition of fine craftsmanship.

Major Swiss contributions to modern watchmaking technology are too numerous for listing here. They would require a volume, perhaps several.

The most significant Swiss contribution to the art and science of watchmaking was their use of 19th century mass production techniques, which had originated in the United States.

The adaptation of mass production methods to the highly specialized needs of watchmaking by the Swiss made possible the use of standardized, interchangeable watch parts in the assembly and repair of precision watches.

But this tremendously important advance in watchmaking went far beyond the usual advantages evident in mass production: that is, the capacity to produce more watches at lower cost, and to replace worn parts quickly and inexpensively. It became possible to ship quantities of parts world-wide to service watches, rather than having to return the watch to the maker in Switzerland.

The real triumph of Swiss engineering and technical genius was the ability to design and produce machine tools and machines capable of making more precise watch parts than can be turned out by the most exacting and painstaking master watchmaker. In fact, some Swiss machines can accomplish tasks beyond human capability. Consequently, the traditional skill of the master craftsman can be concentrated on the assembling and testing of a finer watch at a lower cost to the consumer.

Switzerland - The Nation That Times The World

The result of this fortuitous combination of traditional skill and technological sophistication has been to make Switzerland the undisputed leader in the watchmaking industry -- the nation that times the world.