Watches

1850–1980

M. Cutmore

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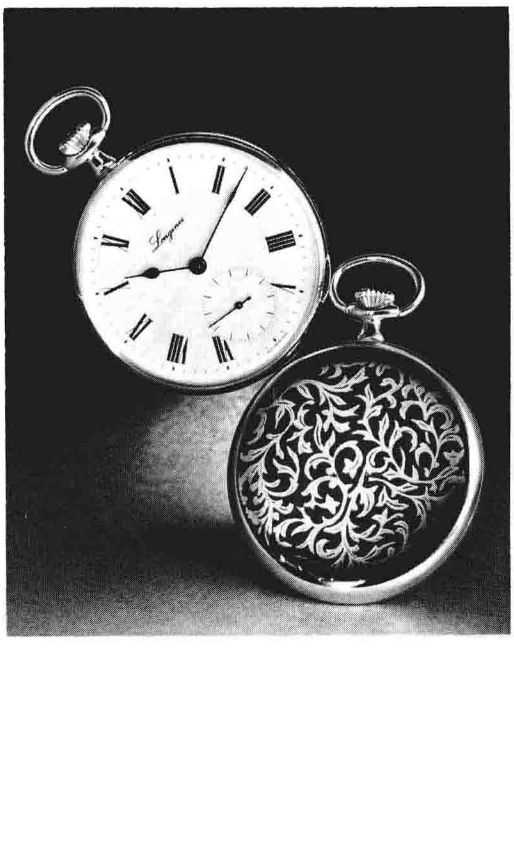

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The Watch Collector's Handbook
The Pocket Watch Handbook

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Preface

If you look in a jeweller's shop window it is clear that most of the watches displayed are electronic, and that fashion is a dominant feature. Dramatic changes have occurred in the last decade, and a few years ago, realising that the mechanical watch with a familiar tick would soon become a thing of the past, I started to think about its history. It was immediately apparent that, although a great deal has been written about antique watches made by traditional methods, very little has been published about the post-1850 period when watches were made in factories and production rose dramatically. In 1850 about two and a half million watches were made in a year; today this quantity is produced in a single working day. This book is about the period from 1850 onwards and most of my spare time in the last five years has been spent researching the subject in libraries, museums and factories in Europe. Scores of letters have been written to various parts of the world, and as the list of acknowledgements shows, help has been forthcoming.

Although there is published information about American and Swiss activities almost nothing has been written about English watch factories or about the influence of engineering on watchmaking. About one third of this book is devoted to these aspects as a positive contribution to published knowledge. Illustrations in the book serve differing purposes. It is necessary to show the different styles of watch in the period and the significant changes in design, and the American and Swiss illustrations fulfil this task. The English photographs have, however, been chosen to enable identification of manufacturer so that movements are the main display. Many of the photographs had to be taken by the author when a watch or movement became temporarily available. These will be seen to be adequate for their purpose but not of professional quality.

The outcome is a book which has given me great pleasure to produce largely because of the welcome I received in so many places. It is clearly too short to give detailed coverage of 140 years of watchmaking, but is, however, a coherent story as a base for future work and tells of the demise of the mechanical watch and the rise of the electronic watch. It covers the rise and fall of American watchmaking, the failure of the English firms, the survival of the diminished Swiss industry and the rise of Far East watchmaking.

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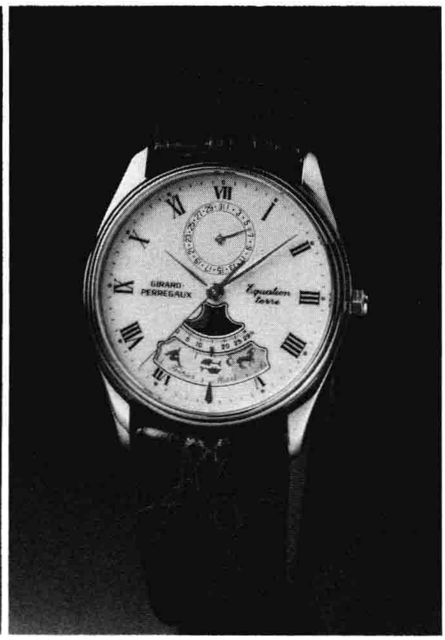

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Contents

1 Watches and watchmaking before 1850

The development of watches by reducing the size of spring-driven clocks probably occurred before 1500. A watch, initialled C.W., is kept in the Wuppertal museum in Germany and is dated 1548.[1] Another early example dated 1551, signed Jacques de la Garde, can be seen at the Louvre in Paris. These two watches enable the essential components to be identified as a case, a dial with a hand to indicate the time and a movement to drive the hand through motion work (Fig 1). The spring powering the movement was contained in a drum-shaped barrel and the spring torque was kept constant by a stackfreed or a fusee and applied to the escapement through the train of wheels. The escapement was controlled by an oscillating balance.

With each vibration one tooth of the escape wheel was allowed to pass and the whole train and hand moved forward a tiny increment. Provided the balance vibration rate was constant the watch would keep good time. All the parts in the movement rotate and therefore have staffs or arbors which are supported in bearing holes in two plates. The plates are placed above and below most of the movement parts and are separated by pillars. The plates not only support the arbors and loads but also protect the fragile parts of the movement. Unfortunately the most fragile part, which is the oscillating balance, was usually placed outside the plates so losing this protection, and it needed a special upper bearing known as the cock which was pinned (later screwed) to the plate.

The stackfreed was a short-lived torque-regulating device but the fusee was used in some watches until c1900. When a fusee is used the spring in the barrel has its outer end attached to the barrel circumference and the inner end to the barrel arbor. A length of gut (later chain) is attached to and wound around the outside of the barrel circumference, the other end being attached to the fusee. The spring is wound by rotating the fusee with a key so uncoiling the gut from the barrel and recoiling it into a spiral groove cut in the cone shaped profile of the fusee (Fig 1). When the spring is fully wound the force transmitted to the fusee by the gut acts at the smallest radius and as the spring unwinds, reducing the force transmitted, the fusee radius increases to maintain a constant torque output to the train.

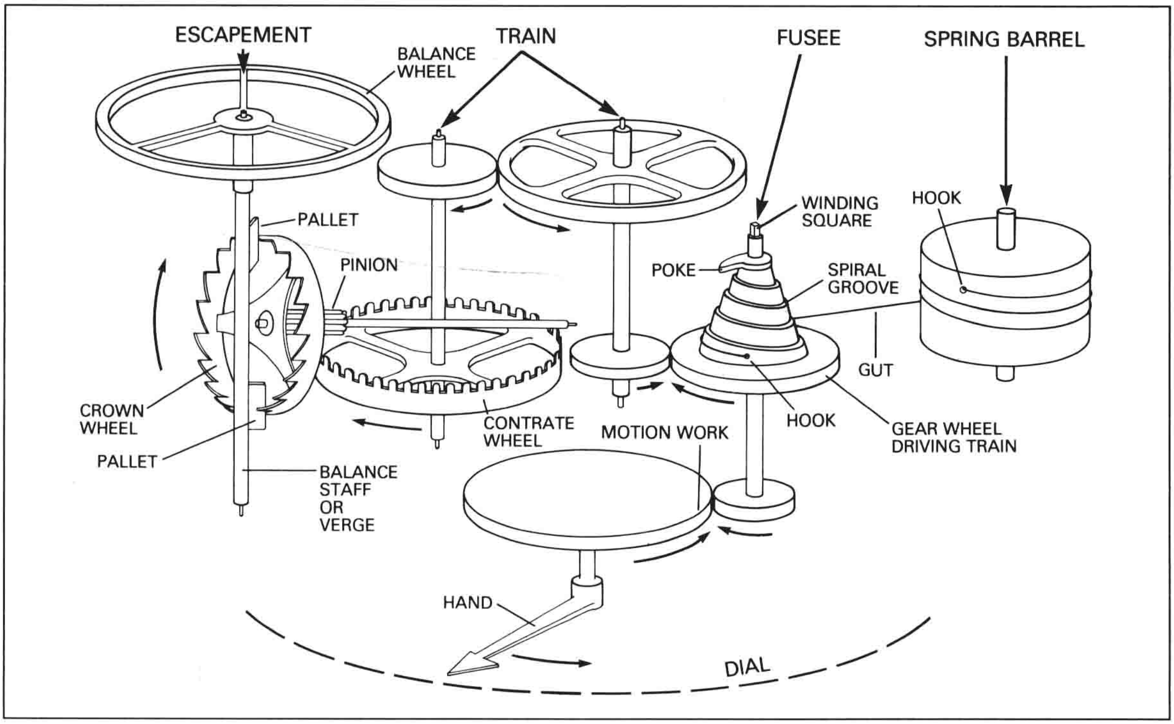

Fig 1 The essential components of an early watch movement; note the torque equalising fusee

Even with this torque regulation the early watch was a poor timekeeper and the next two hundred and fifty years were spent in turning the watch into a good but relatively expensive timekeeper. Soon after this was achieved new manufacturing techniques were developed and watches became cheaper and available to everyone. Factory-made watches are the concern of this book but it is first necessary to outline the previous developments which determined the form of the watch and the methods used to make it in 1850.

In the period until 1675 improvements in the watch were limited to replacement of the fusee gut by a chain, complete elimination of the stackfreed, improvement in timekeeping by worm and wheel adjustment of the initial spring tension (set-up), and increasing complications in the information the watch could give – striking, alarm setting, day, date, moon phase, etc. The casework changed to a shape suitable for the pocket rather than hanging from the neck which was the way early watches were worn and a watchglass was fitted giving better protection to the movement from dust and damp. There were also considerable forms of case decoration, enamel work in particular became evident.

As the watchmaking craft became established in various countries so skills improved and the watches produced benefitted. In England in 1631, the Worshipful Company of Clockmakers was formed as a guild to ensure the standard and quality of the work of clockmakers and watchmakers and to ensure the proper training of apprentices.[2] This was a very significant step and no doubt contributed to the excellence of English watches in the eighteenth century. In due course it will be seen that some traditions become fixed in the minds of some watchmakers and in turn contributed to the demise of the industry in the late nineteenth century.

The introduction of the balance spring to the watch in 1675 by Christian Huygens and Robert Hooke was the first significant step in improving watch performance. It was equivalent to the use of the pendulum in the clock (1657). It was hoped that the use of the balance spring would cause isochronous vibrations (constant time of vibration irrespective of the arc of vibration) but it was not so and it was a further 100 years before escapement, design and balance spring fitting techniques made this possible. The timekeeping improvement caused by the balance spring was so enormous that two hands were fitted enabling time to be read to the minute and seconds hands were also occasionally fitted. Regulation of the timekeeping of the watch with a balance spring could be achieved by altering the active length of the balance spring with a pivoted pair of curb pins.

Once the balance spring watch could be regulated new faults became apparent. It was discovered that changes in temperature of the watch affected its performance. As the temperature increased, the balance spring became less stiff, causing the watch to lose. The second fault was that the position of the watch affected the timekeeping because of gravitational effects. A third was that friction in the escapement was unpredictable.

Navigation of vessels at sea depends on knowing latitude and longitude. To navigate it was necessary to keep good time so that the position of the sun could be accurately determined and the longitude calculated. In order to promote the development of a longitude quality timekeeper a prize of £20,000 was offered in 1714 by the (British) Board of Longitude for a timekeeper which would meet their specification.[3] This prize was eventually awarded to John Harrison in 1773 (the actual award-winning tests were carried out in 1761–2 and 1764). Harrison's design was ingenious but was not the eventual practical answer to the problem. He did, however, contribute two items to watch development, the first being the principle of temperature compensation for which he used a bimetallic curb acting on the balance spring and the second being the principle of maintaining power so that a fusee watch did not stop whilst being wound. A small tensioned leaf spring inside the fusee base supplied power during winding. Harrison did not provide a new escapement for his navigation instrument nor was his temperature compensation curb acting on the balance spring the final solution.

Other makers, notably in England, John Arnold and Thomas Earnshaw, invented a frictionless, detached detent escapement for use in marine chronometers and both Arnold and Earnshaw used temperature compensated bimetallic balance wheels rather than bimetallic balance spring curbs. Pierre le Roy and Ferdinand Berthoud were involved in similar work in France. In the form used in watches, the compensation balance has its rim made of two layers of metal, brass on the outside and steel inside. The rim is cut close to the balance arms (Fig 2). When temperature rises the brass expands more than the steel and the cuts allow the rim arms to bend inwards which shortens vibration time. If temperature falls the arms bend outwards increasing vibration time. Although this correction for temperature change is not perfect, this design gives a considerable improvement in timekeeping in a watch.

The timekeeping of a watch can be further improved by using special terminal curves at the ends of the balance spring. Arnold discovered the correct shape for a helical balance spring and Abraham-Louis Breguet the form of an overcoil for the spiral spring used in watches. Breguet (1747–1823) was a great watchmaker working mainly in Paris from 1762 onwards (with interruptions due to revolution and war). During his lifetime he invented several improvements including the tourbillon in which the escapement rotated to reduce errors to watch position.

In some ways it was surprising that Harrison did not approach the problem of friction in the escapement design since watchmakers were aware of the problem. The original escapement used in the first clocks and watches (Fig 1) is known as the verge escapement. There is continuous friction during its action between the teeth of the crown (or escape) wheel and the pallets on the balance staff (or verge). The first new watch escapement was introduced by George Graham in about 1726. It is known as the cylinder escapement and may well be a development of the design described in British patent 344 of 1695 to Booth, Houghton and Tompion (Graham was related to Tompion by marriage). In Graham's form, the escape wheel has a vertical arbor and teeth which project vertically from the rim of the wheel (Fig 3). These teeth give impulse to the balance by means of a special slot cut in a hollow cylinder fitted into the balance wheel staff. The working portion of the cylinder has approximately half its circumference removed so that a tooth may escape by passing through the cut-away portion at the appropriate moment during the

Fig 2 Bimetallic temperature compensation devices used in watches. The curb was never common and was not used in modern watches