THE TIME TRAIN

The previous chapter gave an overall view of the Morbier clock with some indication of the development of the mechanism and the cases over its 200-year history. This section gives further details of the time train with particular emphasis on the verge or crown wheel escapement that is found on most of the clocks built up to about 1880 and brief treatments of the more familiar anchor escapement used in later years and the pinwheel escapement, which is found occasionally.

The Verge Escapement

For most people the verge escapement is something they had read about many years ago when they first became interested in clocks or watches. Any history usually shows at least one picture of an early clock of the fifteenth or sixteenth century with a foliot balance and mentions its poor accuracy. Such books quickly move on to the pendulum clock and to anchor and deadbeat escapements and leave one with the impression that verge escapements were quickly supplanted by these later developments. Collectors of European watches, on the other hand, know that the verge escapement was used in thousands of watches well into the nineteenth century.

Therefore, it comes as a surprise when one sees a verge escapement in a Morbier clock, the first impulse is to think that one has stumbled onto a really early clock of the fifteenth or sixteenth century (Figure 20).

Most likely, however, the clock is little more than a hundred years old, although in some cases it may date from the time of the French Revolution or earlier. Some hints on establishing the date of these clocks were given in earlier paragraphs.

The second idea one has of the verge escapement, namely, that it is fundamentally inaccurate, is also very likely to be abandoned after one has observed such a clock for several weeks or months. In modern American houses where the temperature remains fairly constant, this weight-driven clock is surprisingly accurate and will keep time with all but the best regulators. It is not often recalled that Harrison's chronometer No. 4, with which he eventually won the Admiralty award, was essentially a big watch with a verge escapement and temperature compensation. Although later chronometers used more advanced (and more delicate) escapements, Harrison proved that with superior craftsmanship and attention to detail the verge escapement could perform as well as the more complicated mechanisms.

Nevertheless, the verge escapement in lantern clocks had serious weaknesses when used with the short pendulum. During the seventeenth and eighteenth centuries there was a great deal written about the strengths and weaknesses of the verge escapement, which at that time, was practically the only one available for use in watches. In almost all instances these early writers recognized that friction during recoil was the real enemy in verge escapements in watches and most clocks of the

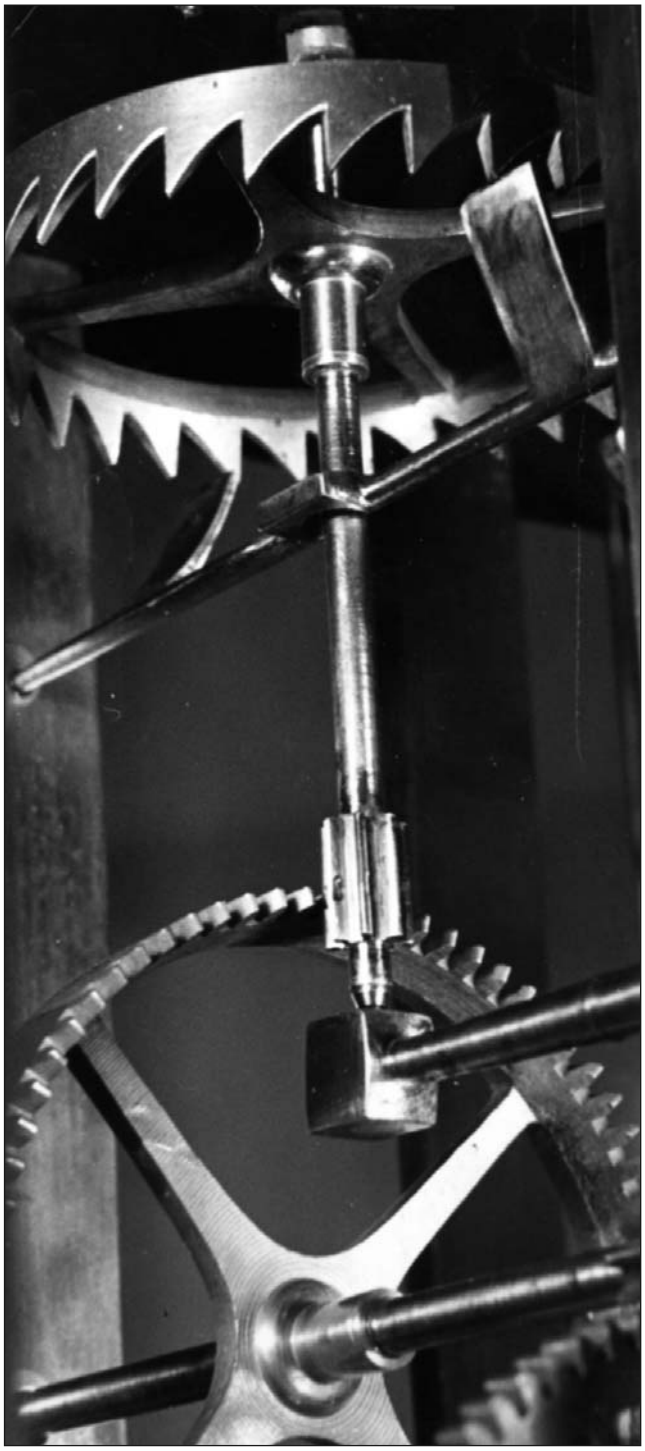

Figure 20. The verge escapement as found in the classic Morbier from about 1750 to 1880.

period. A study of the accompanying diagrams reveals why this is so and shows how the design of the escapement in Morbier clocks overcomes this defect to a great extent.

Figure 21 is a diagram of the verge escapement used in lantern clocks after the introduction of the pendulum. The portion to the right of the center line in these schematic drawings represents the part of the wheel and the pallet in front, whereas the shaded part on the left represents the pallet and part of the escape wheel behind. In this sketch tooth (a) has just escaped from pallet (A) as the verge and the pendulum

swing in a counterclockwise direction and tooth (b) has dropped on pallet (B) which, still moving in a counterclockwise direction, causes the escape wheel to recoil to the left against the force of the train which impels it to the right. The line along which the pressure of the escape wheel acts to resist can be seen to be at an angle of about 40 degrees with a perpendicular to the surface of the pallet. The relatively short length and wide angle of the pallets mean that there is considerable friction and wear when the movement of the pendulum causes the escape wheel to recoil.

Figure 22 shows the proportions of the verge escapement usually found in the Morbier clocks and indicates the relation of the parts at the beginning of recoil. The force acts at an angle of about 20 degrees with the perpendicular to the surface of the pallet or half that shown in Figure 22. The Morbier clocks have longer pallets in proportion to the depth of engagement in the escape wheel, a smaller angle between the pallets, and curved working faces of the pallets that bring them more nearly perpendicular to the plane of rotation of the escape wheel teeth. As a result there is less relative motion of the escape wheel teeth with respect to the pallet, and wear and friction are reduced more than in the lantern clock escapement.

The dimensions of a typical lantern clock of about 1700 and a Morbier of perhaps 1800 are compared in Table I.

As far as I have been able to determine verge escapements with such proportions were used only in Morbier clocks.[3] Apparently, the French theoreticians of the mid-eighteenth century were no longer interested in the verge escapement for clocks, and it was left to the practical clockmakers of the Jura to work things out independently. Outside of France, only relatively short pallets requiring a large amplitude of the pendulum were used.

Another unusual feature of the Morbier clock is that it combines a verge escapement with a long pendulum beating seconds or even longer in a relatively narrow case. Lantern clocks using verge escapements have short pendulums either directly mounted on the verge or, when they are driven by a crutch, the suspension spring is essentially coaxial with the verge so the arc of the pendulum is the same as that of the verge. This is a disadvantage because of the circular error in large arcs of the pendulum. Various devices were developed before the invention of the anchor escapement to reduce the arc of the pendulum while retaining the verge escapement. For example, Huyghens developed a gearing arrangement, and in the so-called Zaandam clocks there is another system using a vertical verge and a horizontal rod that is linked to the pendulum at about one-third its length so that the arc of the verge is greater than the arc of the pendulum.

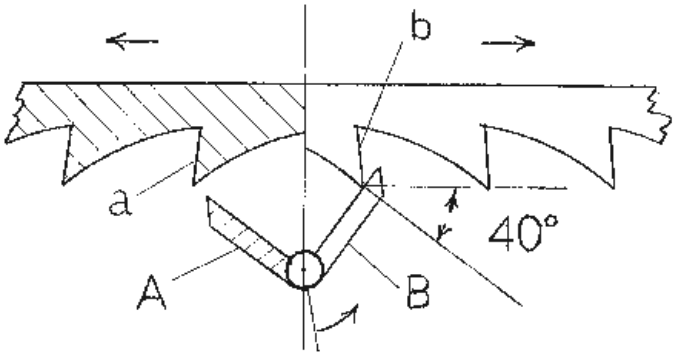

Figure 21, left. Verge escapement used in lantern clocks and bracket clocks 1650-1750 (shown inverted for comparison with Figure 22).

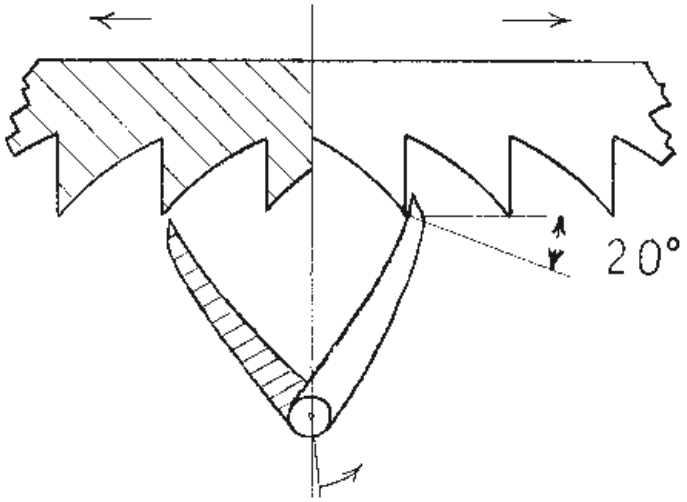

Figure 22. Verge escapement used in Morbier clocks 1750-1880.

TABLE I

	Lantern Clock	Morbier
Diameter of escape wheel	35.0 mm	55.0 mm
Number of teeth	15	31
Distance between teeth	7.5 mm	5.5 mm
Angle between pallets	90°	58°
Length of pallets	6.0 mm	13.5 mm
Depth of pallets in escape wheel	2.0 mm	1.8 mm
Ratio of depth to length of pallets	1:3	1:7.5

In the earlier Morbier clocks the "steeple" that carries the thread suspension is quite high, sometimes as much as four inches above the top plate of the frame. With the linking arrangement used in the Morbier clocks this means that the arc of the verge is greater than the arc of the pendulum since the radius of the former is less. For example, in the clock shown in Figure 28, the distance from the thread suspension to the pivot for the horizontal link is 9-1/2 inches, whereas the distance from the pallet arbor pivot to the link is about 3-1/2 inches. Thus, the arc of the verge is nearly three times the arc of the pendulum.