THE HUNTERIAN

## Alexander Bain Electric Pendulum Clock – Additional information

### How did it all begin?

Between 1841 and 1852 Scottish-born Alexander Bain (1810-1877) took out a series of patents for electrically-driven pendulum clocks. The Hunterian's clock relates to an Edinburgh patent from 1845. His clocks were electrically driven, and capable of electrically controlling other geographically distant clocks. Bain realised the technical possibilities of connecting clocks electrically: one central clock could drive many others, exactly synchronised. In 1846, Bain tested his theory. He installed a telegraph line alongside the railway from Edinburgh to Glasgow and showed how one of his electric clocks in Edinburgh could be used as a master to synchronise a connected clock in Glasgow.

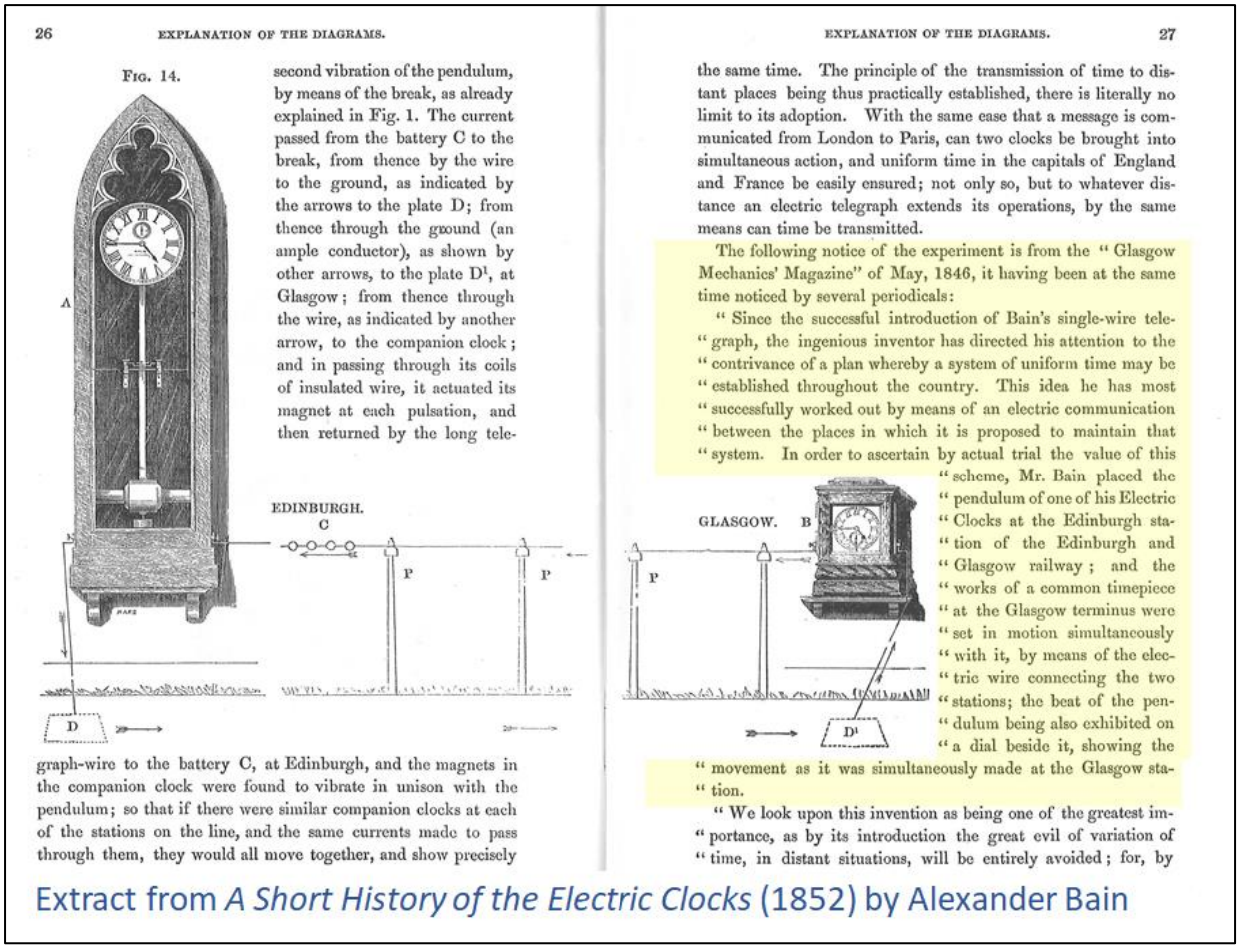

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FIG. 14.



second vibration of the pendulum, by means of the break, as already explained in Fig. 1. The current passed from the battery C to the break, from thence by the wire to the ground, as indicated by the arrows to the plate D; from thence through the ground (an ample conductor), as shown by other arrows, to the plate $D^1$, at Glasgow; from thence through the wire, as indicated by another arrow, to the companion clock; and in passing through its coils of insulated wire, it actuated its magnet at each pulsation, and then returned by the long telegraph-wire to the battery C, at Edinburgh, and the magnets in the companion clock were found to vibrate in unison with the pendulum; so that if there were similar companion clocks at each of the stations on the line, and the same currents made to pass through them, they would all move together, and show precisely

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the same time. The principle of the transmission of time to distant places being thus practically established, there is literally no limit to its adoption. With the same ease that a message is communicated from London to Paris, can two clocks be brought into simultaneous action, and uniform time in the capitals of England and France be easily ensured; not only so, but to whatever distance an electric telegraph extends its operations, by the same means can time be transmitted.

The following notice of the experiment is from the "Glasgow Mechanics' Magazine" of May, 1846, it having been at the same time noticed by several periodicals:

"Since the successful introduction of Bain's single-wire telegraph, the ingenious inventor has directed his attention to the contrivance of a plan whereby a system of uniform time may be established throughout the country. This idea he has most successfully worked out by means of an electric communication between the places in which it is proposed to maintain that system. In order to ascertain by actual trial the value of this scheme, Mr. Bain placed the pendulum of one of his Electric Clocks at the Edinburgh station of the Edinburgh and Glasgow railway; and the works of a common timepiece at the Glasgow terminus were set in motion simultaneously with it, by means of the electric wire connecting the two stations; the beat of the pendulum being also exhibited on a dial beside it, showing the movement as it was simultaneously made at the Glasgow station.



"We look upon this invention as being one of the greatest importance, as by its introduction the great evil of variation of time, in distant situations, will be entirely avoided; for, by

Extract from *A Short History of the Electric Clocks* (1852) by Alexander Bain

**How was it powered?**

Bain's original designs were powered by an 'earth battery' consisting of two electrodes, one made of zinc, the other made of copper or carbon, buried in the moist ground. The pendulum bob contains a coil of wire, and the two brass "arms" fastened to the clock case contain permanent magnets. The electrodes in the ground created a circuit inducing a small but stable current to flow through a coil of wire within the pendulum bob.

**Where did the pendulum fit in?**

The pendulum operated a sliding switch – here's how:

The electric current running through the coil had the effect of making the pendulum temporarily magnetic. When put in motion by a small push, the pendulum was attracted to one of the two permanent magnets inside brass tubes on the sides of the clock case. As the pendulum swung, a sliding switch higher up the pendulum rod passed over and beyond gold contact points, breaking the circuit (like an 'off' switch). With no electric current, the pendulum is no longer magnetic and so its own weight pulled it the other way.

As the pendulum swung back in the opposite direction, the switch closed to its 'on' position, completing the circuit again. This meant the pendulum bob was once again magnetic and being pulled to the opposite permanent magnet. So the process continued leading to the familiar back and forth movement or "oscillation".

The motion of the pendulum itself drove the clockwork, and the pulsating current could be readily routed (by cabling) to drive duplicate clocks elsewhere.

**What is different about an *electric* pendulum clock?**

Unlike nearly all other pendulum clocks, where the clockwork drives the pendulum, Bain's system was the reverse of that. This was marvellously ingenious and as well as the ability to drive other clocks, it did not need to be wound up. However, it did not keep time accurately, since the pendulum was not isolated from outside influence as it is in a normal clock. Thus, our clock must be regarded as a pioneer rather than as a prototype.