

## The Clayton Tunnel Disaster

August 25th 1861

Three heavy trains leave Brighton for London Victoria on a fine Sunday morning. They are all scheduled to pass through the Clayton Tunnel—the first railway tunnel to be protected by a telegraph protocol designed to prevent two trains being in the tunnel at once. Elsewhere, safe operation is to be guaranteed by a time interval system, whereby consecutive trains run at least 5 minutes apart. On this occasion, the time intervals between the three trains on their departure from Brighton are 3 and 4 minutes.

There is a signal box at each end of the tunnel. The North Box is operated by Brown and the South by Killick. K has been working for 24 hours continuously. In his cabin, he has a clock, an alarm bell, a single needle telegraph and a handwheel with which to operate a signal 350 yards down the line. He also has red (stop) and white (go) flags for use in emergency, with three indications:

When K sends a train into the tunnel, he sends an OCCUPIED signal to B. Before he sends another train, he sends an IS LINE CLEAR? request to B, to which B can respond CLEAR when the next train has emerged from the North end of the tunnel. The dial at one end of the telegraph only displays OCCUPIED or CLEAR when the appropriate key is being pressed at the other—it otherwise displays NEUTRAL.

The distant signal is to be interpreted by a train driver either as *all clear* or as *proceed with caution*. It is designed to operate automatically so that it returns to danger as a train passes it, but if this automatic mechanism fails, it rings the alarm in K's cabin.

### The accident

When train 1 passed K and entered the tunnel the automatic signal failed to work. The alarm rang in K's cabin. K first sent an OCCUPIED message to B, but then found that train 2 had passed the defective signal before he managed to reset it. K picked up the red flag and displayed it to Scott, the driver of train 2, just as his engine was entering the tunnel. He again sent an OCCUPIED signal to B.

K didn't know whether train 1 was still in the tunnel. Nor did he know whether S had seen his red flag. He sent an IS LINE CLEAR? signal to B. At that moment, B saw train 1 emerge from the tunnel, and responded CLEAR. Train 3 was now proceeding with caution towards the tunnel, and K signalled all clear to the driver with his white flag.

But S had seen the red flag. He stopped in the tunnel and cautiously reversed his train to find out what was wrong from K.

Train 3 ran into the rear of Train 2 after travelling 250 yards into the tunnel, propelling Train 2 forwards for 50 yards. The chimney of the engine of Train 3 hit the roof of the tunnel 24 feet above. In all 23 passengers were killed and 176 were seriously injured.

### Box 2. An Account of the Clayton Tunnel Railway Accident

identifying and actively checking the state of the signal also has a conceptual