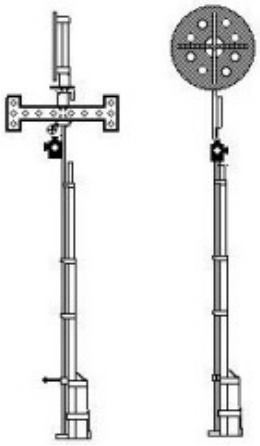
The Early Years

In the earliest days of the railways it soon became obvious that some form of signalling would be required. In the days of horse drawn transport, although speeds were relatively high, a horse could stop quickly and avoid oncoming traffic. Early locomotives, running on a fixed line of rails, had to rely on hand brakes and were unable to stop quickly. Some form of signalling system was essential to avoid accidents.

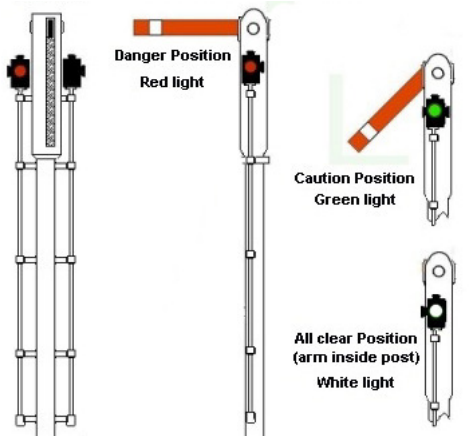
Initially most railways employed 'Policemen' who gave hand signals to warn approaching trains, one arm held sideways for clear, one arm raised above the head for caution and both arms raised above the head for stop. Many of the railway companies initially used their policemen to perform general duties in addition to working points and the signalling of trains. Initially, the time interval system was used. After the passage of a train a danger signal would be displayed for a stipulated time following which a caution signal would be displayed and after a further period a clear signal would be displayed. In theory a fixed interval of time was maintained between trains. As there was no communication between adjacent stations, it was impossible for the policemen to know whether a train had stopped just out of sight and could easily give a false clear indication. When a train was overdue an engine was frequently sent in the wrong direction to look for it. Often the train was found all too suddenly and running at speed. The search engine had to be reversed quickly to avoid a head-on collision. Primitive as these arrangements were, accidents were not as frequent as might be expected, although some were serious and caused casualties.



By the beginning of the 1840s the policemen's duties were concentrated on signalling matters and fixed signals began to replace hand signals. These took on various forms such as flags fixed in frames, flat boards or discs or balls on posts raised or lowered as appropriate. Only two indications were given Stop or Proceed but usually only one was displayed positively the other being denoted by the absence of a signal. Furthermore, indications varied between different railways some giving a positive signal for danger whereas elsewhere the absence of a signal meant danger.

The Great Western Railway introduced one of the earliest fixed signals, the disc and crossbar and this showed positive indications for both stop and clear. The crossbar for 'stop' was mounted at right angles to the disc for 'clear', the signal being turned through 90 degrees to show the appropriate indication.

The illustrated signal shows the cross bar for a level crossing.



The London & Croydon Railway was one of the first to introduce semaphore signals. These showed three positions by means of an arm mounted in a slotted post. Different indications were given by the position of the arm, horizontal for stop; downwards at 45 degrees for caution; vertical (in fact invisible inside the post) for clear. At night coloured lights were used, red for stop, green for caution, white for clear.

At this time, points and signals were generally operated by individual levers at the site of the signal. By the mid 1850s the levers for points and signals started to be grouped together in one frame and elementary forms of interlocking were starting to appear.

The electric telegraph, which enabled messages to be sent between stations, was developed in the mid nineteenth century but many railways continued to use the time interval system, either because they could not aford the cost of installation or their employees were not sufficiently literate to use it. Some of the first instances of the telegraph system being used, was to protect timing through long tunnels. Telegraph operators at both ends of the tunnel would spell out messages to each other letter by letter when trains entered and left the tunnel.

The use of the electric telegraph was gradually extended to other sections of the line. And the cumbersome method of transmitting letter by letter gave way to a simplified version, in which an electric current passing through an electromagnet could hold a single needle deflected to right or left to indicate 'train on line' or 'line clear'.

This development permitted the replacement of the time interval system by the 'block' system as the signalmen at adjoining stations could now communicate with each other. The section of line between stations was known as the 'block section' and this automatically gave a space interval between trains.

Single-stroke bells were developed about the same time and these with the principle that only one train should be allowed in the section at one time, formed the basis on which the modern signalling of today is based.

[Editor – The Thorpe rail accident occurred on 10 September 1874, when two trains were in head-on collision at Thorpe St Andrew in Norfolk.
The accident occurred on what was then a single-track rail line between Norwich railway station and Brundall. The two trains involved were the 20.40h mail train from Yarmouth and the 1700h express train from London to Yarmouth. The latter had left Norwich Thorpe at 21.30 and would normally have had a clear run on its way to Yarmouth, since the mail train should have been held on a loop line at Brundall to allow the express to pass. On this occasion trains were running late.
In such circumstances, when the timetable was upset, drivers had to have written authority to proceed further. Due to a series of errors, both drivers received their authority, and the drivers, both anxious to make up for lost time, set off at speed along the single track. The accident, when it occurred at around 2145h, resulted in both locomotives rearing into the air, and carriages reduced to wreckage.
Both drivers and firemen were killed, as were 19 passengers. 73 passengers and two railway servants were seriously injured.]

Development of British Signalling - Part II. Ken Chynoweth

Forwards From the Early Years

Once the basic block system had been evolved further developments of signalling systems were largely governed by improved safety. Almost from the start safety on the railways was governed by the Board of Trade through the Railway Inspection Department. The inspection officers were usually former army officers from the Corps of Royal Engineers. New installations had to be inspected and approved to be fit for traffic before any passenger operations could begin. Accidents had to be reported to the Board of Trade and if necessary an inquiry would be carried out. However, the Board of Trade could only recommend actions to prevent a recurrence. Some railways heeded their advice but many, possibly through lack of money, were loath to introduce the new safety devices.
By the 1870's slotted post signals were becoming widely used on many lines. Signals were generally kept in the clear position and were only returned to danger after a train had passed. They were then cleared again when the train had passed into the section ahead, or if the time interval system was still in use, after the prescribed time had elapsed. In 1876 an accident occurred at Abotts Ripton on the Great Northern Railway which led to the abandoning of the slotted post signal. This accident occurred in a blizzard and as the signal arms had become frozen inside the slots in the posts they were not returning to danger behind the train in response to operation of the levers in the signal box . The accident occurred because a freight train was being shunted to clear the line for a following express (actually the Flying Scotsman) but as the signals were showing a false clear position the express proceeded at speed and struck the freight as it was setting back into a siding.
To prevent snow giving a false indication by holding down a semaphore arm, the Great Northern Railway experimented with a centrally balanced arm linked to the spectacle glass on the side of the post. This was known as the "somersault" signal and persisted on Great Northern lines for many years. Other railways also abandoned slotted post signals but opted for the more conventional arrangement of mounting the arm on a simple pivot outside the post. Initially these worked in the lower quadrant showing a red light for danger but continued to exhibit a white light for clear. As this could cause confusion with the increasing use of street lighting the white signal lights were gradually replaced with green to indicate clear.

Somersault signal with the arm in the clear position.
http://www.roscalen.com/signals/Lincoln/WestHolmes.htm

Despite the introduction of the block telegraph the time interval system lingered on many lines. On single lines the danger of a head on collision was more obvious and many companies installed the block system on single lines before dealing with double tracked lines. Some companies dealt with single line operations by using pilotmen and as there was only one pilotman for each stretch of line there was little chance of collision. However, should two trains need to follow each other, the piolotman would instruct the first train to proceed and he would follow on the second one. This led to the system of staff and ticket working in which a wooden staff and paper tickets replaced the pilotman.

The 'staff' had to be shown to, or carried by the driver of every train passing through the section. If two trains had to follow each other before a train was due in the opposite direction the first train was given a ticket and the staff carried by the second train. This system was open to errors which could cause accidents. To overcome this, various forms of interlocked token machines were introduced and these formed the basis of single line operation up to the present day.

In the early days many accidents were caused by drivers not being able to stop as the hand operated brakes then in use were inadequate to stop a train travelling at speed. By the 1870's several Companies were experimenting with various forms of power brake. In 1875 a Royal Commission on Railway Accidents conducted trials of the various systems at Newark to establish the system which gave the best performance. They also recommended that interlocking and the use of the block telegraph should be adopted on all lines. These recommendations were later

endorsed on many occasions by Inspecting Officers, when the lack of these features was held to be responsible for the cause of accidents they were investigating. In 1889 the Regulation of Railways Act made the adoption of the block system, interlocking of points and signals and continuous automatic brakes mandatory. This Act laid down the foundations for railway working as we know it today.

During the latter part of the nineteenth century new developments in signalling were largely designed to cover human error. Many were experimental, for example wheel operated treadles, which could indicate electrically when trains had passed a given point. These could be interlocked with the signals and block instruments thus preventing signalmen from clearing signals before the previous train had passed a safe distance ahead. "Lock and Block" signalling meant that the passage of the trains governed the actions of the signalmen .Early forms of automatic train control were also experimented with in which audible warnings, given by contact with line side equipment, could be given to the driver. Of local interest the Liverpool Overhead Railway used a system of automatic semaphore signalling from its opening in 1893.

In the early years of the twentieth century many of the earlier experimental devices were developed, such as track circuits, colour light signals and automatic control of signals by trains. These laid down the principles for present day semaphore signalling.

Following the First World War further experiments with three position signalling took place. The arms worked in the upper quadrant to avoid confusion with the then standard lower quadrant signals. These signals showed a red light for danger when horizontal, a yellow light for caution when inclined at 45 degrees and a green light for clear when vertical. In effect they were a form of speed signalling although in this country they merely indicated the position of the next signal ahead. Although these signals exhibited a yellow light for caution, standard lower quadrant distant signals were painted red and continued to exhibit a red light for caution, as many signal engineers felt that this emphasised the danger aspect of stopping at the next signal. In
1922 the Institution of Signal Engineers set up a committee to investigate the whole matter of three position signalling.

The committee's report, published in 1924, recommended against the adoption of three position signalling but were in favour of multi-aspect colour light signals using red for danger, yellow for caution and green for clear. The Ministry of Transport endorsed the committee's report and also said that distant signals (which had hitherto been painted red) should be painted yellow and display yellow and green lights at night. As three position signals had been abandoned the way was open for the introduction of upper quadrant two position semaphore signals as there was no possibility of confusion between two and three position signals. The 1924 recommendations were so far reaching that there was no need for any major alterations to the semaphore signalling system for over 40 years.

Somersault signals are a particular favourite of mine, being quite widespread in use on the M&GN [Ed.]
Here we have two between Weybourne and Holt on the North Norfolk Railway.

NRS Railtour 1990[?] A. Banks