away from the window and thus indicates “ all clear.” On the withdrawal or failure of the current the disk falls by gravity to the “ stop ” position. A local battery is used, with a relay, the rail circuit not being strong enough to lift the disk. In the electro-pneumatic system a full-size semaphore is used. Com­pressed air, from pumps situated at intervals of 10 to 20 m., is conveyed along the line in an iron pipe, and is supplied to a cylinder at each signal, exactly as in pneumatic interlocking, before described. The rail circuit, when complete, maintains pressure in a cylinder, holding the signal “ off.” On the entrance of a train or the failure of the current, the air is liberated and the signal arm is carried by gravity to the “ stop ” position.

Automatic signals are sometimes made to stand normally (when no train is in the section) in the “ stop ” position. The local circuit is connected with the rail circuit so that it is closed only when a train is approaching within, say, 1 m. With the rail circuit, distant signals are controlled, without a line wire, by means of a polarized relay. Each signal, when cleared, changes the polarity of the rail circuit for the next section in its rear, and this, by the polarized relay, closes the local circuit of the distant signal, without affecting the home signal for that section.

Automatic signals are used in America on a few single lines. The signal at A for the line AB is arranged as before described; and the signal at B, for movements in the opposite direction, is worked by means of a line wire from A, strung on poles. When a section is occupied, signals are set *two* sections away, so as to provide against the simultaneous entry of two trains.

One of the chief causes of anxiety and difficulty in the working of railway traffic is fog, which practically blots out the whole system of visible signals, so that while the block telegraph re­mains, the means of communicating the necessary in­structions to the driver are no longer effective. Delay and confusion immediately arise; and in order to secure safety, speed has to be lessened, trains have to be reduced in number, and a system of “ fog-signalling ” introduced. In England, especially around London, elaborate arrangements have to be made. “ Fog­signalling ” consists in the employment of audible signals, or de­tonators, to convey to drivers the information ordinarily imparted by the visible or semaphore signals. As soon as possible after a fog comes on, a man is stationed at the foot of each distant signal, and generally of each home signal also, who by means of detonators, red and green flags and a hand-lamp, conveys information to the driver of every train as to the position of the semaphore arm. A detonator is a small flat metal case about 2 in. in diameter and ½ in. deep, furnished with two leaden ears or clips which can be easily bent down to grip the head of the rail. The case contains some detonating composition, which readily explodes with a loud report when a wheel passes over it. As soon as a signal arm is raised to “ danger,” the fogman places upon one of the rails of the track to which the signal applies two detonators, or in the case of a new and improved class of detonator which contains two separate charges in one case, one detonator, and at the same time exhibits a red flag or light to the driver of an approaching train. The engine of a train passing over the detonators explodes them, the noise so made being sufficient to apprise the driver that the signal, though invisible to him, is at danger, and he then should act in the same way as if he had seen the signal. If, however, the signal arm should be lowered to the “ all-right ” position before a train reaches it, the fogman should immediately remove the detonators and exhibit a green flag or lamp, replacing the detonators as soon as the signal is again raised to danger. As a rule the fogmen are drawn from the ranks of the permanent-way men, who otherwise would be idle. But if, as sometimes happens, a fog continues for several days, great difficulty is experienced in obtaining sufficient men to carry on this important duty without undue prolongation of their hours of work. When this happens, signalmen, shunters, porters, yardsmen and even clerks may have to be called on to take a turn at “ fogging.” Some companies have adopted mechanical appliances, whereby a man can place a detonator upon a line of rails or remove it while standing at a distance away from the track, thus enabling him to attend to more than one line without danger to himself. The cost of detonators often amounts to a considerable sum; and an apparatus called an *econo­mizer* has been introduced, whereby the explosion of one detonator removes the second from the rails before the wheels reach it. As it is only necessary for one detonator to explode, the object of placing two on the rails being merely to guard against a miss-fire, consider­able saving can thus be effected. Many attempts have been made to design a mechanical apparatus for conveying to a driver the re­quisite information as to the state of the signals during a fog, and for enabling the fogmen to be dispensed with. Such inventions usually consist of two parts, namely (1) an inclined plane or block or trigger, placed on the permanent way alongside the track or between the rails, and working in connexion with the arm of the signal; and (2) a lever or rod connected with the steam-whistle, or an electric bell or indicator on the foot-plate, and depending from the under-side of the engine in such a position as to come in contact with the apparatus on the ground, when the latter is raised above the level of the rails. Most of the proposed systems only give an indication when the signal is at danger, and are silent when the signal is off. This is contrary to good practice, which requires that a driver should receive a positive indication both when the signal is "off ” as well as when it is "on.” If this is not done, a driver may, if the signal is “ off ” and if the fog is thick, be unaware that he has passed the signal, and not know what part of the line he has reached. The absence of a signal at a place where a signal is usually exhibited should invariably be taken to mean danger. Fog signalling machines that depend on the ex­plosion of detonators or cartridges have the drawback that they require recharging after a certain number of explosions, varying with the nature and size of the machine. Even when a satisfactory form of appliance has been discovered, the manner of using it is by no’ means simple. It is clearly no use placing such an apparatus im­mediately alongside a stop signal, as the driver would receive the intimation too late for him to be able to stop at the required spot. To place devices of this description at or near every stop signal in a large station *or* busy junction would involve a multiplication of wires or rods which is undesirable. Every such apparatus should certainly be capable of giving an “ all-right ” signal as well as a “ danger" signal. It requires very careful maintenance, and should be in regular daily use to ensure its efficiency.

The fundamental principles of railway signalling are simple, but the development of the science has called for much study and a large money outlay. On every railway of any consequence the problems of safety, economy and convenience are involved, one with another, and cannot be perfectly solved. Even so fundamental a duty as that of guarding the safety of life and limb is a relative one when we have to consider whether a certain expenditure is justifiable for a given safety device. Having good discipline and foregoing the advantages of high speed, many a manager has successfully deferred the introduction of signals; others, having to meet severe competition, or, in Great Britain, under the pressure of the government, have been forced to adopt the most complete apparatus at great cost. In large city terminal stations, where additions to the space are out of the question, interlocking is necessary for economy of time and labour, as, indeed, it is in a less degree at smaller stations also; as a measure of safety, however, it is desirable at even the smallest, and the wise manager extends its use as fast as he is financially able. At crossings at grade level of one railway with another, and at drawbridges, interlocked signals with derailing switches obviate the necessity of stopping all the trains, as formerly was required by law everywhere in America, and saving a stop saves money. The block system was introduced primarily for safety, but where trains are frequent it becomes also an element of economy. Without it trains must usually be run at least five minutes apart (many managers deem seven or ten minutes the shortest safe interval for general use), but with it the interval may be reduced to three minutes, or less, according to the shortness of the block sections. With automatic signals trains are safely run at high speed only 1½ m. apart, and on urban lines the distance between them may be only a few hundred yards. (B. B. A.; II. Μ. R.)

**SIGNATURE** (through Fr. from Lat. *signatura, signare,* to sign, *signum,* mark, token, sign), a distinguishing sign or mark, especially the name, or something representing the name, of a person used by him as affixed to a document or other writing to show that it has been written by him or made in accordance with his wishes or directions (see Autograph, Monogram, &c.). In the early sense of something which “ signifies,” *i.e.* marks a condition, quality or meaning, the word was formerly also used widely, but now chiefly in technical applications. In old medical theory, plants and minerals were supposed to be marked by some natural sign or symbol which indicated the particular medicinal use to which they could be put; thus yellow flowers were to be used for jaundice, the "scorpion-grass,” the old name of the forget-me-not, was efficacious for the bite of the scorpion; many superstitions were based on the human shape of the roots of the mandrake or mandragora; the bloodstone was taken to be a cure for hemorrhage; this theory was known as the “ doctrine of signatures.” (See T. J. Pettigrew, *Superstitions connected with Medicine or Surgery,* 1844.) In printing or book-